6.0 Routine Environmental Monitoring

The current scope of environmental monitoring addresses water (both surface water and groundwater), ecology, and air. Section 6.1 addresses water monitoring, Section 6.2 describes ecological monitoring, and Section 6.3 summarizes air monitoring.

The RFLMA consultative process will be followed to discuss any modifications to the monitoring that is performed in accordance with RFLMA (i.e., as defined in Attachment 2 to RFLMA). Consultation will be documented in a RFLMA Contact Record (see Section 15.2.1) and incorporated into Attachment 2 to RFLMA during the next revision of RFLMA.

6.1 Water Monitoring

The primary objective of all water monitoring at the Site is protection of surface water quality. Groundwater is monitored because groundwater contaminant plumes occur within the COU boundaries (Figure 6–1) and have the potential to degrade surface water quality. Groundwater is monitored along pathways to surface water to provide early detection of potential impacts to the surface water quality. The contaminants of interest include various VOCs, nitrate, and uranium. This contamination is the result of decades of production-related activities including waste storage, disposal practices that were acceptable at the time, spills, and leaks. Because of the potential for VOCs, industrial hygiene air monitoring will be performed at select water monitoring locations. Refer to the H&S folder on the RF-Share drive for information on industrial hygiene air monitoring.

The *Interim Measure/Interim Remedial Action for Groundwater at the Rocky Flats Environmental Technology Site* (Groundwater IM/IRA) (K-H 2005) and the RI/FS (DOE 2006a) provide thorough discussions of groundwater contamination at the Site. Summary information about the Individual Hazardous Substance Sites (IHSSs) and the effect of contaminated areas on groundwater during fiscal year (FY) 2004 is presented in Appendix D and earlier versions of the *Integrated Monitoring Plan* (IMP) (K-H 2004a, 2004b), in the *Rocky Flats Cleanup Agreement* (RFCA) Annual Groundwater Monitoring Reports issued for the years 1996 through 2003 (K-H 1997, 1998a, 1999, 2000a, 2001, 2002b, 2004c, 2004d), and in the *Fate and Transport Modeling of Volatile Organic Compounds at the Rocky Flats Environmental Technology Site* (VOC Modeling Report) (K-H 2004e). More thorough information on IHSSs and other contaminant source areas is presented in the original and annual updates to the *Historical Release Report* (HRR) (DOE 1992 and, for example, DOE 2006d, respectively).

Accelerated actions that are currently monitored include the soil removal actions at IHSS 118.1, Trenches T3/T4, Ryan's Pit, the Mound, and Oil Burn Pit #2; the groundwater enhancements at the Property Utilization and Disposal (PU&D) Yard, 903 Pad, and Ryan's Pit; and the groundwater plume treatment systems installed downgradient of the Mound, East Trenches (former OU 2), the former Solar Evaporation Ponds (SEP) (former OU 4), and the PLF. See RFLMA Attachment 2, Figure 2 for corresponding location information.

Surface water is similarly monitored to detect impacts from groundwater and runoff and to confirm the water quality is consistent with expected conditions. Surface water is defined here as water flowing above ground in natural or manmade channels and water detained in Site retention

ponds. Surface water may originate as water flowing from upgradient sources, precipitation[5], or groundwater discharge to the surface via seeps.

A consultative process was used to define the water monitoring network, determine the function of each location in the network, and identify the decisions supported by information from each location. DOE, CDPHE, EPA, and other stakeholder entities were directly involved in this process. RFLMA (Attachment A2) addresses water monitoring and specifies the locations, analytical requirements, and frequencies of data collection. This RFSOG provides additional information to assist Site staff in meeting the requirements of RFLMA and the CAD/ROD (Attachment A1).

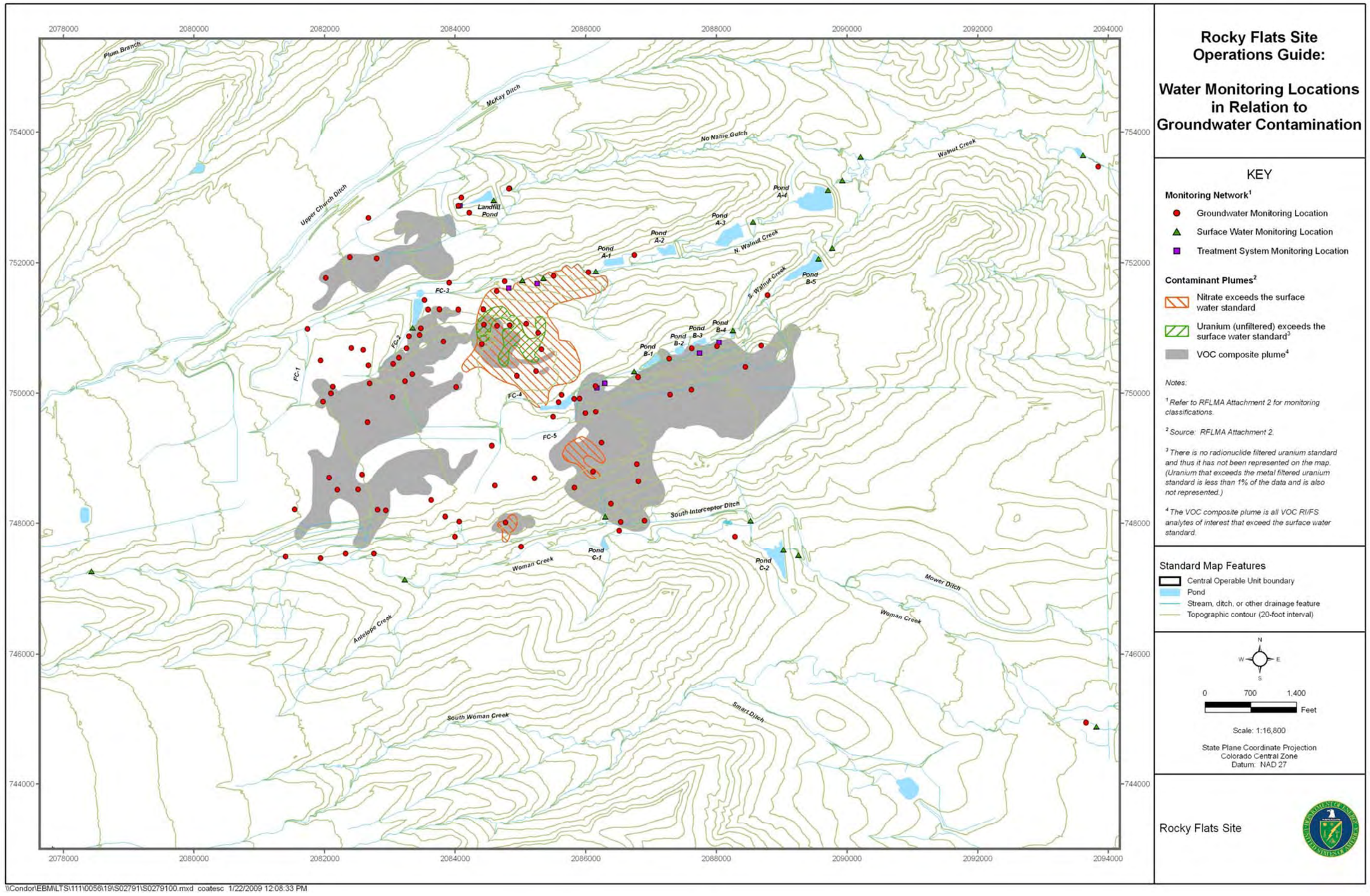
Groundwater and surface water monitoring will be conducted using methods and procedures established for the Site, in accordance with the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351) (SAP). This document describes procedures, methods, and QA requirements for collecting and validating monitoring data. Regulatory standards for surface water and groundwater at the Site are provided in Table 1 of Attachment 2 to RFLMA. Laboratory detection limits need to be set to enable comparison with the corresponding standards. Specific monitoring locations, analyte suites, and sampling frequencies are provided in Table 2 of Attachment 2 to RFLMA. Note that the monitoring and maintenance plans for the PLF and OLF (Attachments D2 and D1, respectively) specify analytical methods that must be employed for water samples collected from monitoring locations supporting those features.

Figure 6–2 shows specific monitoring locations referenced under each monitoring objective. In the interest of fiscal and operational efficiency, some of these locations collect data to support multiple monitoring objectives. The location codes on Figure 6–2 are those used in the Site Environmental Evaluation for Projects (SEEPro) database and the Geospatial Environmental Mapping System (GEMS). SEEPro contains both pre- and post-closure locations and data; GEMS is limited to post-closure locations and data.

Specific data collection protocols are discussed in the following water monitoring sections. Section 10.3 describes the procedures for handling samples once they are collected. Each water monitoring section includes a brief description of the monitoring objective, a map of the locations, and tables detailing the data collection and evaluation protocols. RFLMA requires that analyte concentrations be compared against the greater of the standard, practical quantitation limit (PQL), or temporary modification (TM) listed in Table 1 of Attachment 2 to RFLMA, or to the appropriate uranium threshold also defined in the attachment and discussed further below. The surface water standards, PQLs, and TMs are hereafter referred to collectively as “surface water standards” or “standards.”

Water monitoring objectives are summarized in Table 6−1.

[5] Precipitation gages are positioned across the Site to collect representative Sitewide variations and allow for areal precipitation calculations.



Rocky Flats Site Operations Guide:

Water Monitoring Locations in Relation to Groundwater Contamination

KEY

Monitoring Network[1]

- Groundwater Monitoring Location
- Surface Water Monitoring Location
- Treatment System Monitoring Location

Contaminant Plumes[2]

- Nitrate exceeds the surface water standard
- Uranium (unfiltered) exceeds the surface water standard[3]
- VOC composite plume[4]

Notes:

[1] *Refer to RFLMA Attachment 2 for monitoring classifications.*

[2] *Source: RFLMA Attachment 2.*

[3] *There is no radionuclide filtered uranium standard and thus it has not been represented on the map. (Uranium that exceeds the metal filtered uranium standard is less than 1% of the data and is also not represented.)*

[4] *The VOC composite plume is all VOC RI/FS analytes of interest that exceed the surface water standard.*

Standard Map Features

- Central Operable Unit boundary
- Pond
- Stream, ditch, or other drainage feature
- Topographic contour (20-foot interval)

N, W, E, S

0 700 1,400 Feet

Scale: 1:16,800

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

Rocky Flats Site

Figure 6–1. Water Monitoring Locations in Relation to Groundwater Contamination

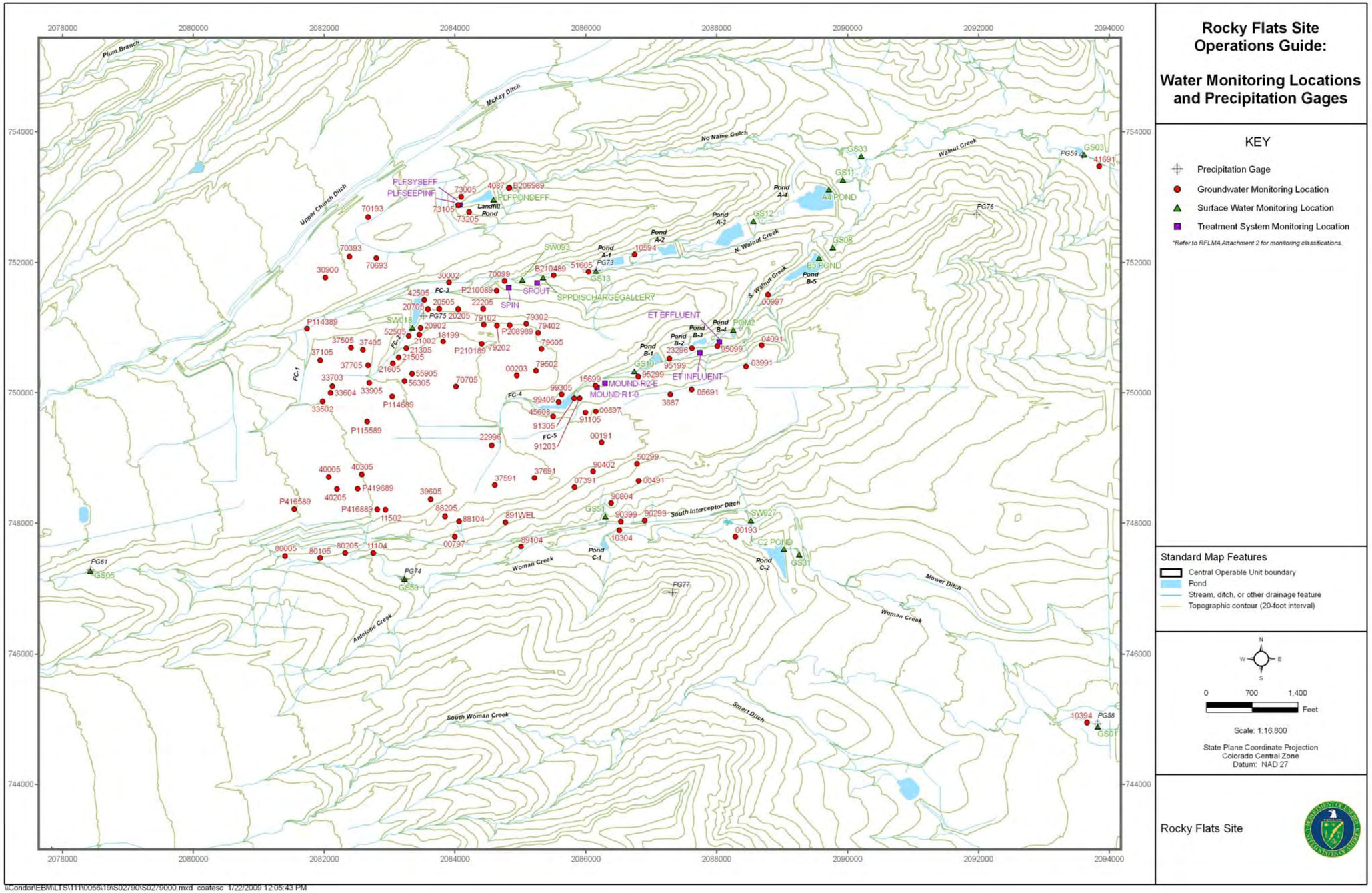


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Figure 6–2. Water Monitoring Locations and Precipitation Gages

Table 6−1. Generalized Water Monitoring Objectives

Monitoring Objective[a]	Media	General Description	Number of Locations[b]	Sampling Frequency
Point of Compliance (POC)	**SW**	**Monitoring of discharges from the terminal ponds into Woman and Walnut Creeks and streamflow downstream at Indiana Street to demonstrate compliance with surface water quality standards.**	**5**	**Flow-paced (varies)**
Point of Evaluation (POE)	**SW**	**Monitoring of runoff and baseflow from the COU to the A-, B-, and C-Series Ponds to evaluate water quality in comparison to surface water quality standards.**	**3**	**Flow-paced (varies)**
Area of Concern (AOC) and Surface Water Performance	**GW, SW**	**Wells within a drainage and downgradient of a contaminant plume or group of contaminant plumes; also surface water monitored downgradient of a source-removal action. Monitored to determine whether the plume(s) may be discharging to surface water.**	**10**	**Semiannually**
Boundary	**GW**	**Located on the east boundary of the POU, where Walnut Creek and Woman Creek cross Indiana Street. Used to demonstrate that contaminants are not migrating off federal land. These wells are not required by the CAD/ROD, but are included in RFLMA as operational monitoring.**	**2**	**Annually**
Sentinel	**GW**	**Typically located near downgradient edges of contaminant plumes, in drainages, and downgradient of groundwater treatment systems. Monitored to determine whether concentrations of contaminants are increasing, which could indicate plume migration or treatment system problems.**	**37**	**Semiannually**
Evaluation	**GW**	**Typically located within groundwater plumes and near plume source areas, or in the interior of the COU. Data from these wells will help determine when monitoring of an area or plume can cease. A subset of these wells is located in areas that may experience significant changes in groundwater conditions as a result of closure activities.**	**42**	**Biennially (every 2 years)**
Investigative	SW	Monitoring upstream of POCs and POEs to provide support for source evaluations. This monitoring objective is not required by the CAD/ROD or RFLMA, but is included as operational monitoring.	5	Flow-paced (varies)
RCRA	**GW**	**Dedicated to monitoring the PLF and OLF.**	**10**	**Quarterly**
OLF Surface Water	**SW**	**Dedicated to monitoring surface water upgradient and downgradient of the OLF to confirm the effectiveness of the remedy.**	**2**	**Flow-paced (varies), and quarterly grabs**
Treatment System	**GW, SW**	**Four groundwater treatment systems collect and treat contaminated groundwater and discharge the treated water to surface water. Each system is monitored, at a minimum, for influent and effluent water quality, and for impacts to surface water downstream of the effluent discharge point. Not all locations are required by the CAD/ROD or RFLMA; some are included in the network as operational monitoring.**	**13**	**GW: Semiannually SW: Semiannually, quarterly, monthly (varies by monitoring objective)**
Pre-discharge	**SW**	**Pre-discharge sampling of Ponds A-4, B-5, and C-2, or any other upstream pond functioning as a terminal pond, as a BMP to indicate compliance with surface water quality standards. This monitoring objective is not required by the CAD/ROD, but is included in RFLMA as operational monitoring.**	**3**	**Varies – based on discharge frequency**
No Name Gulch Flow Monitoring	SW	Monitoring streamflow in No Name Gulch at the confluence with Walnut Creek to determine relative streamflow contributions. This monitoring objective is not required by the CAD/ROD or RFLMA, but is included as operational monitoring.	1	Not applicable
Indicator Parameter Monitoring	SW	Monitoring for general water quality and quantity information to be used for various data assessments. This monitoring objective is not required by the CAD/ROD or RFLMA, but is included as operational monitoring.	10	Varies by primary monitoring objective[2]
Water Level	GW	Located between areas being actively monitored and in areas subject to changing flow conditions. Also available to support groundwater evaluations if needed. Only water level data will typically be collected from these wells. These wells are not required by the CAD/ROD or RFLMA, but are included in the network as operational monitoring.	8	Varies – minimum of quarterly to semiannually

Notes: [a]Monitoring objectives for groundwater wells are also referred to as well classifications. Objectives listed in **bold** are required by RFLMA.
[b]Surface water locations can serve multiple monitoring objectives. Groundwater wells may also serve multiple data needs, but are only assigned a single well classification.

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6.1.1 Point of Compliance (POC) Monitoring

This objective deals with monitoring discharges from the terminal ponds into Woman and Walnut Creeks and streamflow downstream at Indiana Street to demonstrate compliance with surface water quality standards (see Table 1 of Attachment 2 to RFLMA). Terminal pond discharges will be monitored by POCs GS11, GS08, and GS31. Walnut Creek will be monitored at Indiana Street by POC GS03. Woman Creek will be monitored at Indiana Street by POC GS01. These locations are shown on Figure 6–3.

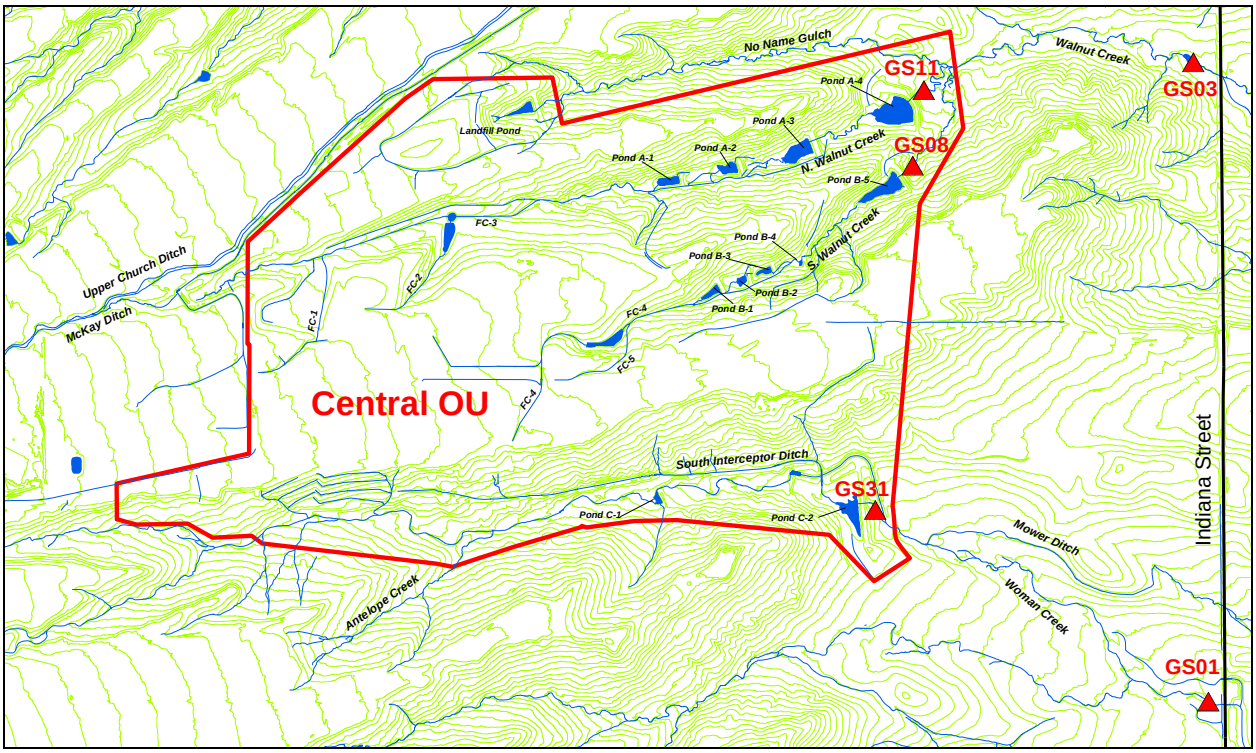


Figure 6–3. POC Monitoring Locations

Data and Sample Collection Protocols

Details on the instrumentation for the five POC locations are provided in Table 6−2. Continuous flow and precipitation data are collected using automated instrumentation (Table 6−3).[6] POCs collect continuous flow-paced composite samples for select analytes (Table 6−4). The method used to determine appropriate flow-pacing for composite samples is discussed in Section 8.1.1. Sample scheduling targets are listed in Table 6−5. Composite samples must be segregated based on water origin (natural creek flows or terminal pond discharges commingled with natural flows).

[6] Precipitation data are not required for this objective; flow measurement is required to flow-pace the automated samplers.

Table 6−2. POC Monitoring Locations

Location Code	Location Description	Primary Flow Measurement Device	Telemetry?
GS01	Woman Creek and Indiana Street	18-inch Parshall Flume[a]	Yes
GS03	Walnut Creek and Indiana Street	3-foot HL-Flume	Yes
GS08	Pond B-5 outlet	24-inch Parshall Flume	Yes
GS11	Pond A-4 outlet	24-inch Parshall Flume	Yes
GS31	Pond C-2 outlet	24-inch Parshall Flume	Yes

Notes: [a]This flume is located east on Indiana Street and is owned by the Woman Creek Reservoir Authority; DOE has a Use Agreement with the Woman Creek Reservoir Authority to use this flume (see Attachment A5); sampling for POC GS01 takes place west of Indiana Street within the Refuge boundary.

Table 6−3. POC Field Data Collection: Parameters and Frequency

Location Code	Flow Rate	Precipitation
GS01	15-minute continuous	5-minute continuous
GS03	15-minute continuous	5-minute continuous
GS08	15-minute continuous	NA
GS11	15-minute continuous	NA
GS31	15-minute continuous	NA

Notes: All locations collect both 5- and 15-minute interval flow data.
NA = not applicable

Table 6−4. POC Sample Collection: Type and Analytes

Location Code	Type[a]	Analytes
GS01	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]
GS03	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]; nitrate[c]
GS08	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]; nitrate[c]
GS11	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]; nitrate[c]
GS31	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]

Notes: [a]Sample types are defined in Section 8.1.1.
[b]Isotopes U-233,234; U-235; U-238
[c]Nitrate will be analyzed for samples collected *only* at Walnut Creek POCs and *only* during terminal pond discharges. Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.

Table 6−5. Annual POC Monitoring Targets (Number of Composite Samples)

Time Period	Pond A-4 (GS11)	Pond B-5 (GS08)	Pond C-2 (GS31)	Walnut Creek at Indiana Street (GS03)	Woman Creek at Indiana Street (GS01)	Total Number of Samples
Discharges	14	14	7	14	7	56
Storm and Baseflow[a]						
October	NA	NA	NA	1	1	2
November	NA	NA	NA	0	1	1
December	NA	NA	NA	1	2	3
January	NA	NA	NA	0	2	2
February	NA	NA	NA	1	2	3
March	NA	NA	NA	4	5	9
April	NA	NA	NA	6	6	12
May	NA	NA	NA	4	6	10
June	NA	NA	NA	1	1	2
July	NA	NA	NA	0	0	0
August	NA	NA	NA	1	1	2
September	NA	NA	NA	0	0	0
Annual Total	14	14	7	33	34	102

Notes: [a]The storm and baseflow monthly sample distribution is based on expected water availability that is predicted from historic flow data. This distribution is intended to be periodically modified as additional flow data are collected.
NA = not applicable

With the removal of impervious surfaces at the Site, flow volumes have decreased significantly. In addition, hydrologic modeling and recent monitoring data have indicated that in a typical year with discharges taking place, estimated discharge volumes from Ponds A-4, B-5, and C-2 would be approximately 10 to 12, 5 to 7, and 3 to 4 MG, respectively. Based on variability of past monitoring data, and to achieve sufficient confidence for decision making, annual frequency targets for Pond A-4 will be one composite for every 790,000 gallons of discharge volume, targets for Pond B-5 will be one composite for every 430,000 gallons, and targets for Pond C-2 will be one composite for every 500,000 gallons. Additionally, no more than one composite per day of discharge will be collected for logistical purposes. For annual planning purposes, 14 composites will be collected from Pond A-4, 14 from Pond B-5, and 7 from Pond C-2, resulting in the collection of 35 total composite samples from terminal pond POCs (see Table 6−5).

The Indiana Street POCs collect the same number of samples as the terminal ponds during discharges, plus additional samples from storm runoff and baseflow between discharges. GS01 will collect seven samples for the expected Pond C-2 discharges. Storm runoff and baseflow samples will be collected based on historic flow data. Based on variability of past monitoring data and to achieve sufficient confidence for decision making, the frequency target for storm runoff and baseflow sampling at GS01 is 27 composites per year, with a maximum target of six samples during any one month (see Table 6−5).

GS03 will collect the targeted 14 samples during Pond A-4 and Pond B-5 discharges. GS03 will collect the same number of composite samples as the terminal pond POCs for each discharge. Ponds A-4 and B-5 will be discharged concurrently, where possible. Based on variability of past

monitoring data and to achieve sufficient confidence for decision making, the frequency target for storm runoff and baseflow sampling at GS03 is 19 composites per year, with a maximum target of six samples during any one month (see Table 6−5).

The sample counts given in Table 6−5 are annual targets only. During dry years, it is unlikely the targets will be achieved.

Data Evaluation

Compliance with surface water quality standards (see Table 1 of Attachment 2 to RFLMA) at POCs is demonstrated according to the Figure 5 flowchart in RFLMA. Methods for calculating the appropriate compliance values are discussed in Section 8.2.1.

Generally, analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical result is higher than the standard for a particular analyte, then the compliance values are calculated immediately. If the compliance values suggest a reportable condition, then validation is requested for all data packages used in the calculation. The desired evaluation frequency is semimonthly, within 1 week of the 15th and last day of any given month.

6.1.2 POE Monitoring

This objective deals with monitoring runoff and baseflow from the interior of the COU to the A-, B-, and C-Series Ponds to evaluate water quality in comparison to surface water quality standards (see Table 1 of Attachment 2 to RFLMA). Surface water will be monitored by Points of Evaluation (POEs) SW093, GS10, and SW027 on North Walnut Creek, South Walnut Creek, and the SID, respectively. These locations are shown on Figure 6–4.

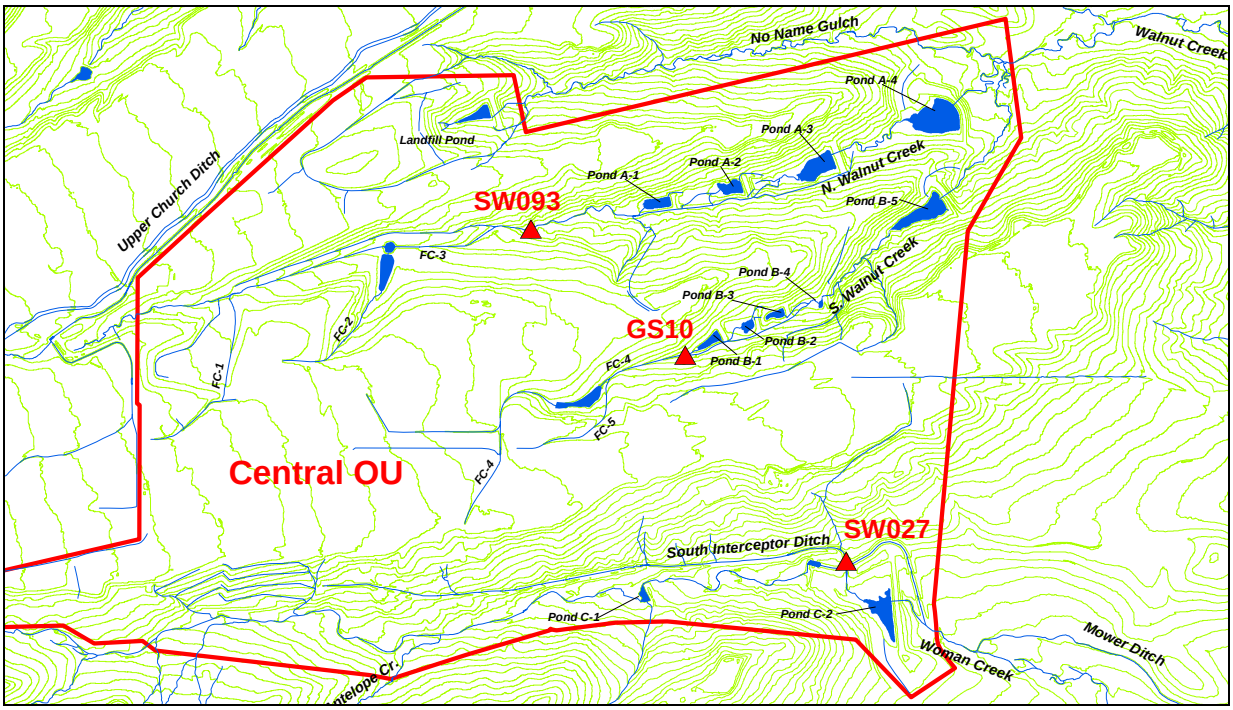


Figure 6–4. POE Monitoring Locations

Data and Sample Collection Protocols

Details on instrumentation for the three POE locations are provided in Table 6−6. Continuous flow data are collected using automated instrumentation (Table 6−7). POEs collect continuous flow-paced composite samples for select analytes (Table 6−8). The method used to determine appropriate flow-pacing for composite samples is discussed in Section 8.1.1. Sample scheduling targets are listed in Table 6−9.

Table 6−6. POE Monitoring Locations

Location Code	Location Description	Primary Flow Measurement Device	Telemetry?
GS10	South Walnut Creek upstream from the B-1 Bypass	9-inch Parshall Flume with weir insert	Yes
SW027	SID just upstream of Pond C-2	Dual Parallel 120° V-Notch Weirs	Yes
SW093	North Walnut Creek 1,300 feet upstream from the A-1 Bypass	3-foot H-Flume	Yes

Table 6−7. POE Field Data Collection: Parameters and Frequency

Location Code	Flow Rate
GS10	15-minute continuous
SW027	15-minute continuous
SW093	15-minute continuous

Note: All locations collect both 5- and 15-minute interval flow data.

Table 6−8. POE Sample Collection: Type and Analytes

Location Code	Type[a]	Analytes
GS10	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]; total Be and Cr; dissolved Cd and Ag
SW027	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]; total Be and Cr; dissolved Cd and Ag
SW093	Continuous flow-paced composites	Pu-239,240; Am-241; isotopic U[b]; total Be and Cr; dissolved Cd and Ag

Notes: [a]Sample types are defined in Section 8.1.1.
[b]Isotopes U-233,234; U-235; U-238

Table 6−9. Annual POE Monitoring Targets (Number of Composite Samples)

Month	Number of Samples[a]			
	SW093	GS10	SW027	Total
October	1	2	1	4
November	1	1	0	2
December	1	1	0	2
January	1	1	0	2
February	1	1	0	2
March	2	2	2	6
April	3	3	5	11
May	2	1	4	7
June	1	1	1	3
July	0	0	1	1
August	1	1	1	3
September	0	0	0	0
Annual Total	14	14	15	43

Notes: [a]Monthly sample distribution is based on expected water availability that is predicted from historic flow data. This distribution is intended to be periodically modified as additional flow data are collected.

Based on variability of past monitoring data, and to achieve sufficient confidence for decision making, annual frequency targets for SW093, GS10, and SW027 will be 14, 14, and 15 composites, respectively. Additionally, no more than five composites per month will be targeted (see Table 6−9).

The sample counts listed in Table 6−9 are annual targets only. During dry years, it is unlikely the targets will be achieved.

Data Evaluation

Evaluation of analytical results in comparison to surface water quality standards (see Table 1 of Attachment 2 to RFLMA) at POEs is performed according to the Figure 6 flowchart in RFLMA. Methods for calculating the appropriate values for comparison are discussed in Section 8.2.1.

Generally, analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical result is higher than the standard for a particular analyte, then the compliance values are calculated immediately. If the compliance values suggest a reportable condition, then validation is requested for all data packages used in the calculation. The desired evaluation frequency is semimonthly, within 1 week of the 15th and last day of any given month.

6.1.3 AOC Wells and SW018

Area of Concern (AOC) wells (Figure 6–5) are located to evaluate potential groundwater impacts to surface water. Impacts will be based on a minimum of two routinely scheduled sampling events in a row, not on a single data point. Analytical results from AOC wells are compared directly against the appropriate surface water standards in Table 1 of Attachment 2 to RFLMA or

the uranium threshold. Analytical data from surface water performance location SW018, where grab samples for VOCs are collected to support groundwater objectives, are assessed in a manner similar to data from AOC wells.

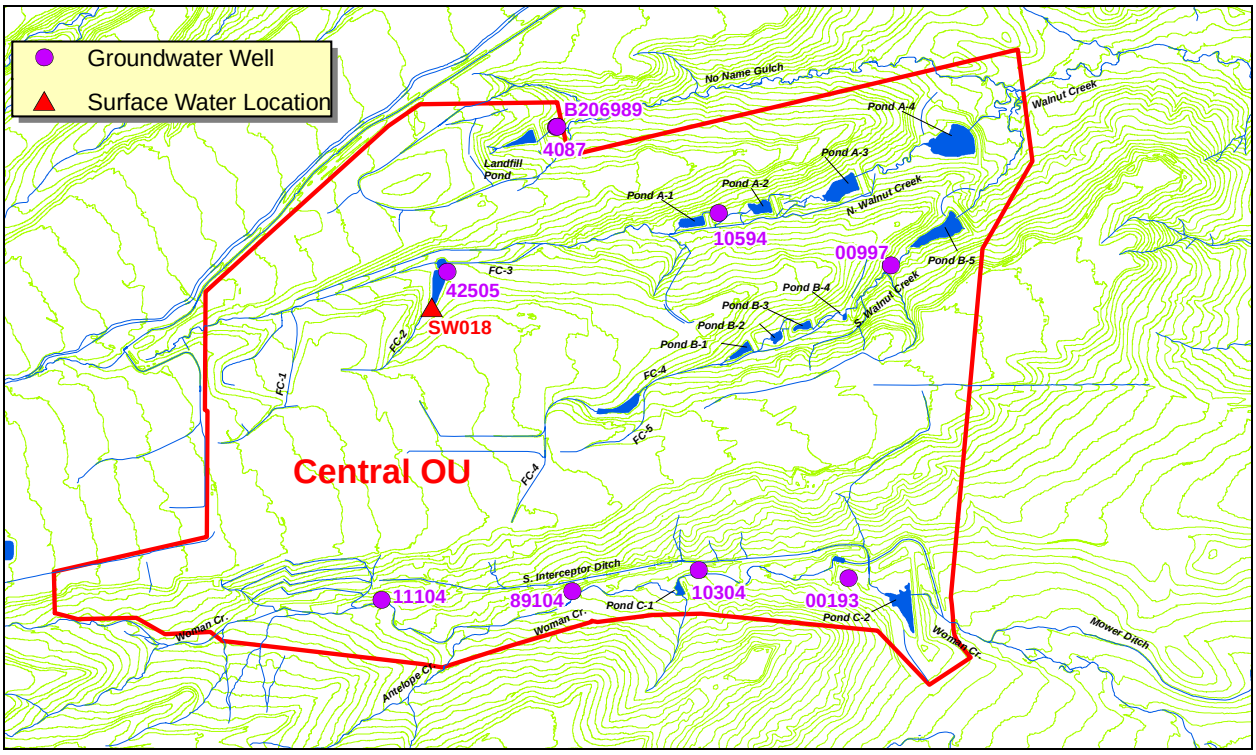


Figure 6–5. AOC Well and SW018 Locations

Data and Sample Collection Protocols

General monitoring information for AOC wells and SW018 is provided in Table 6−10. Sampling frequencies are summarized in Table 6−11.

The data evaluation process guiding the use of analytical data from AOC wells and SW018 is shown on the Figure 7 flowchart in RFLMA (Attachment A2); because similar rules guide the use of data at Boundary wells, this figure applies to both well classifications.

Additional explanation is warranted for surface water station SW018, discussed here with AOC wells. This location is in the unnamed tributary to North Walnut Creek that is part of the larger FC-2 drainage and is generally downgradient (west-northwest) of IHSS 118.1. This IHSS was the site of historic spills of carbon tetrachloride that created a pool of dense nonaqueous-phase liquid within an excavation formed in the lower-permeability claystone, in which a carbon tetrachloride tank was installed. The IHSS was remediated by source removal followed by backfilling the excavation with Hydrogen Release Compound® (HRC®) in 2004; however, an associated plume of VOC-contaminated groundwater persists. The historic flow direction of this plume was toward the west and the tributary to North Walnut Creek. The predicted post-closure flow direction is more northerly, generally toward Sentinel well 20505. To assess whether the plume is impacting surface water in the unnamed drainage, SW018 is monitored for VOCs.

Table 6−10. AOC Wells and SW018

Location Code	Location Description	Analytes[a]
00193	Woman Creek upstream of Pond C-2	VOCs, U
00997	South Walnut Creek upstream of Pond B-5	VOCs, U, nitrate
10304	Southeast of 903 Pad/Ryan's Pit Plume at Woman Creek	VOCs, U, nitrate
10594	North Walnut Creek downstream of Pond A-1	VOCs, U, nitrate
11104	Downgradient, downstream of the OLF and downgradient of the IA Plume	VOCs, U
4087	Below Landfill Pond	VOCs, U, nitrate
42505	Terminus of FC-2	VOCs
89104	Downgradient of OU 1 Plume at Woman Creek	VOCs
B206989	Below Landfill Pond	VOCs, U, nitrate
SW018	Upstream of FC-2 wetland	VOCs

Notes: [a]Samples for the analysis of U will be field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.

Table 6−11. Sampling Frequency for AOC Wells and SW018

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample with other locations monitoring the same plume(s)

Data Evaluation

Compliance with surface water quality standards (see Table 1 of Attachment 2 to RFLMA) at AOC wells and SW018 is demonstrated by the Figure 7 flowchart in RFLMA. Analytical data evaluation is performed as data become available; this is necessary because of the strict timeline attached to "reportable conditions" for AOC wells (the requirement for SW018 is slightly different, as shown on the flowchart). In accordance with and as defined in RFLMA, if the data are confirmed to be valid and meet the requirements of a reportable condition, the reporting process is initiated.

The data will be reviewed to determine whether monitoring may be discontinued as upgradient monitoring ceases and analytical results at a given AOC well (or SW018) reach the exit requirements described on the data evaluation flowchart in RFLMA (Figure 7, Attachment A2). Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.4 Boundary Wells

Boundary wells (Figure 6–6) are located at the Walnut Creek/Indiana Street and Woman Creek/Indiana Street intersections and are monitored to assure surrounding stakeholders that groundwater leaving the historic RFP in these drainages is not adversely impacted by the Site.

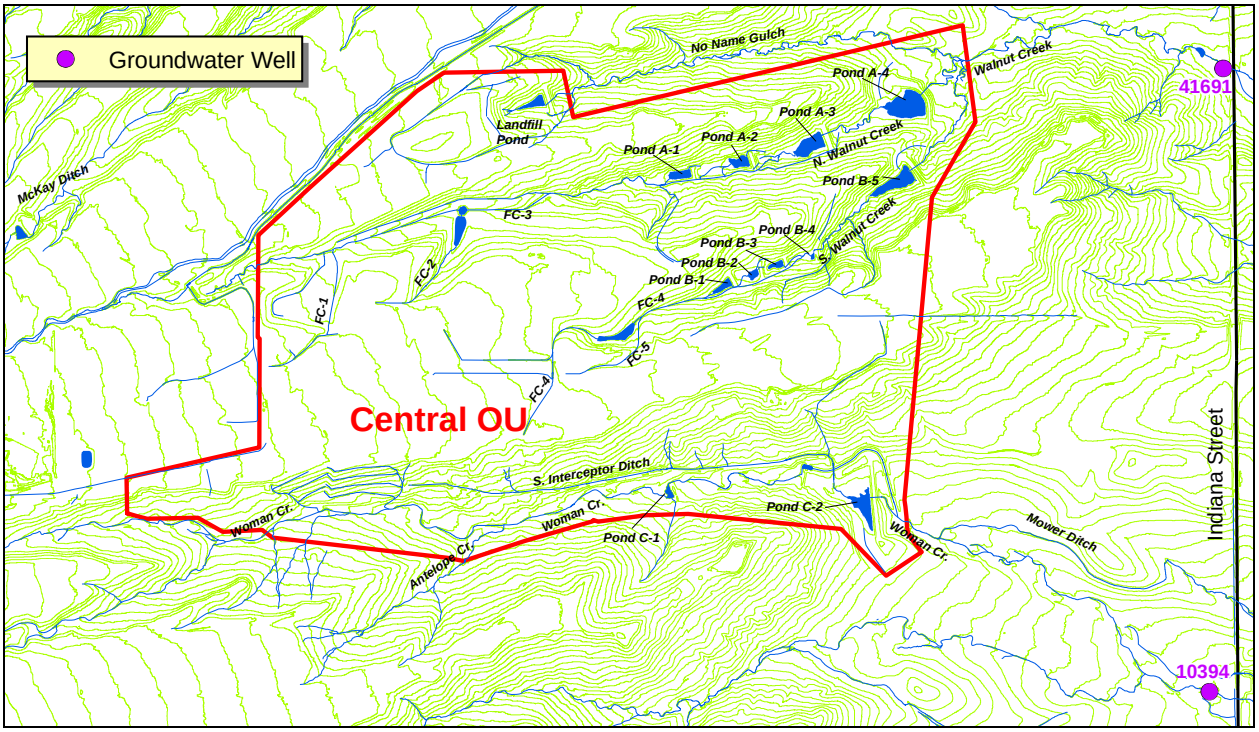


Figure 6–6. Boundary Well Locations

Boundary wells are not required by the CAD/ROD, nor have they supported the technical groundwater monitoring requirements defined by the preceding IMPs (e.g., DOE 2006e, 2006f). However, these wells are included in the network to satisfy operational monitoring requirements in RFLMA (Attachment A2).

Data and Sample Collection Protocols

General monitoring information on Boundary wells is provided in Table 6−12. Sampling frequencies are summarized in Table 6−13.

Table 6−12. Boundary Wells

Location Code	Location Description	Analytes[a]
10394	Woman Creek at Indiana Street	VOCs, U, nitrate
41691	Walnut Creek at Indiana Street	VOCs, U, nitrate

Notes: [a]Samples for the analysis of U will be field-filtered using a 0.45-micron in-line filter. Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.

Table 6−13. Sampling Frequency of Boundary Wells

Sampling Frequency	Timing	Schedule Considerations
Annual	Second calendar quarter (high-water conditions)	None

The data evaluation process guiding the use of analytical data from Boundary wells is shown on the Figure 7 flowchart in RFLMA (Attachment A2). Because similar rules guide the use of data at AOC wells and SW018, this figure applies to both well classifications.

Data Evaluation

Compliance with surface water quality standards (see Table 1 of Attachment 2 to RFLMA) at Boundary wells is demonstrated by the Figure 7 flowchart in RFLMA. Analytical data evaluation is performed as data become available; this is necessary because of the strict timeline attached to "reportable conditions" for Boundary wells. In accordance with and as defined in RFLMA, if the data are confirmed to be valid and meet the requirements of a reportable condition, the reporting process is initiated.

The determination of whether monitoring a Boundary well may cease will be made as upgradient monitoring ceases and analytical results at the Boundary well approach exit requirements. When upgradient wells are no longer monitored and concentrations in the Boundary well meet the applicable standards and/or uranium threshold, conditions will be reviewed with the regulatory agencies to seek approval to cease monitoring by well or analyte suite, as appropriate. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.5 Sentinel Wells

Sentinel wells (Figure 6–7) are located near downgradient edges of contaminant plumes, in drainages, at groundwater treatment systems, and along contaminant pathways to surface water. These wells are monitored to determine whether concentrations of contaminants are increasing, thereby providing advance warning of potential groundwater quality impacts to the downgradient AOC well(s). Confirmation of a potential impact to downgradient wells will require an analytical record that consistently indicates an impact, not a single data point that indicates a contaminant has been detected.

Sentinel wells are used to monitor the performance of an accelerated action (including soil/source removals, in-situ contaminant plume treatment, groundwater intercept components of treatment systems, and facility demolitions) and assess contaminant trends at important locations. Data from Sentinel wells are supplemented by those from Evaluation wells and are used to determine when monitoring may cease or additional remedial work should be considered.

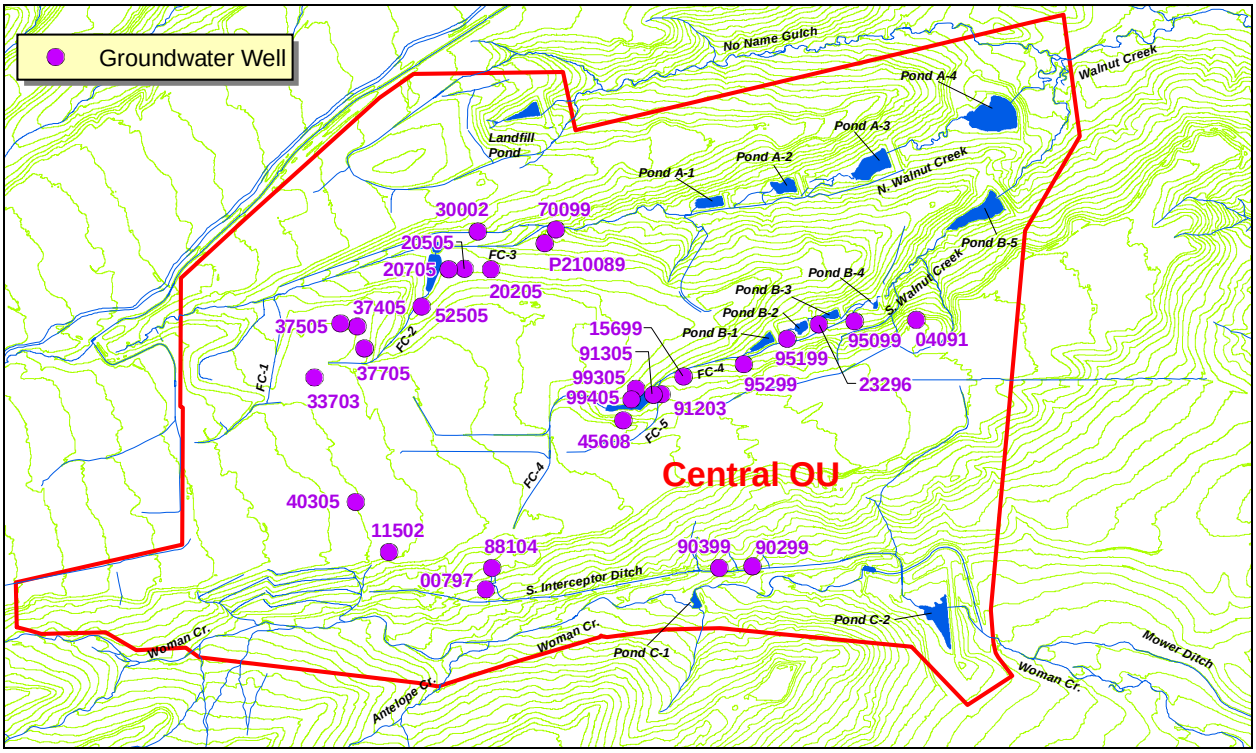


Figure 6–7. Sentinel Well Locations

Data and Sample Collection Protocols

General monitoring information for Sentinel wells is provided in Table 6−14. Sampling frequencies are summarized in Table 6−15.

Table 6−14. Sentinel Wells

Location Code	Location Description	Analytes[a]
00797	South of former Building 881 (B881) area	VOCs, U
04091	East of source area	VOCs
11502	Southeast of former B444 area	VOCs, U
15699	Downgradient of MSPTS intercept trench	VOCs
20205	North/northeast of former B771/774 area	VOCs, U, Pu, Am
20505	North of former B771/774 area	VOCs, U, Pu, Am
20705	North/northwest of former B771 area	VOCs, U, nitrate, Pu, Am
23296	Downgradient of ETPTS intercept trench	VOCs, U
30002	Downgradient at North Walnut Creek	VOCs
33703	Downgradient of source area	VOCs
37405	North/northeastern part of former B371/374 area	VOCs, U, nitrate, Pu, Am
37505	Northern part of former B371 area	VOCs, U, nitrate
37705	East/southeast of former B371/374 area at foundation drain confluence	VOCs, U, nitrate, Pu, Am
40305	Eastern part of former B444 area	VOCs, U
45608	Adjacent to remnants of SW056 French drain and drain interruption[b]	VOCs
52505	West of former IHSS 118.1 area	VOCs
70099	Northwest (sidegradient) of SPPTS intercept trench	U, nitrate
88104	Southern part of former B881 area	VOCs, U
90299	Southeastern part of 903 Pad/Ryan's Pit Plume at SID	VOCs
90399	Southeastern part of 903 Pad/Ryan's Pit Plume at SID	VOCs
91203	Downgradient of Oil Burn Pit #2 source area	VOCs
91305	South of confluence of FC-4 and FC-5	VOCs, U, nitrate
95099	Downgradient of ETPTS intercept trench	VOCs
95199	Downgradient of ETPTS intercept trench	VOCs
95299	Downgradient of ETPTS intercept trench	VOCs
99305	Eastern part of former B991 area	VOCs, U, nitrate
99405	Southeastern part of former B991 area	VOCs, U, nitrate
P210089	Downgradient (north) portion of SPP	VOCs, U, nitrate

Notes: [a]Samples for the analysis of U, Pu, and Am will be field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.
[b]Until RFLMA is updated to reflect a well replacement made in 2008, the requirements applying to well 45608 refer instead to well 45605. Also, requirements associated with well TH046992 (listed in RFLMA, deleted from this table) have been eliminated and that well has been abandoned.
SPP = Solar Ponds Plume

Table 6−15. Sampling Frequency for Sentinel Wells

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample with other locations monitoring the same plume(s)/area(s)

Data Evaluation

Analytical data from Sentinel wells are evaluated according to the Figure 8 flowchart in RFLMA (Attachment A2). Analytical data evaluation may be performed as data become available, but only needs to be reported in the corresponding annual report. For a discussion on the statistical analysis of data, see Section 8.2.2.

If groundwater quality is worsening and fails the criteria described on the Figure 8 flowchart in RFLMA, more thorough assessment and investigation is required. If the 85th percentile concentration of a constituent of interest is greater than the corresponding surface water standard or uranium threshold, as appropriate (Criterion 1), **and** concentrations exhibit a statistically significant increasing trend at 95 percent confidence (Criterion 2), data from the Sentinel wells and upgradient wells will be reviewed. Possible causal factors and conditions will be identified, and actions that may either alleviate these factors and conditions or characterize them adequately for the appropriate action to be identified will be proposed. The analytical data and this discussion will be included in the subsequent periodic report.

Conversely, as monitoring ceases in upgradient wells (i.e., wells monitoring an area of interest or source area where there is a potential for groundwater contamination to migrate to a given Sentinel well), consideration of the exit strategy is warranted. When upgradient monitoring ceases (either entirely or for a given analyte or suite of analytes) and groundwater quality in the given Sentinel well meets both criteria described on the Figure 8 flowchart in RFLMA (Attachment A2), discussions with the regulatory agencies regarding exiting monitoring (again, either entirely or for a given analyte or suite of analytes) will be initiated. If more than one Sentinel well is in the same downgradient direction of the area or plume of interest (as is the case with Sentinel wells 88104 and 00797 downgradient of former Building 881, or wells 90299 and 90399 monitoring the Ryan's Pit/903 Pad Plume), it may be that each of these wells will need to satisfy the exit criteria before discontinuing monitoring. Review of data to determine whether monitoring may cease will be performed as upgradient monitoring and analytical results approach exit requirements. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.6 Evaluation Wells

Evaluation wells (Figure 6–8) are located within groundwater contaminant plumes and near plume source areas, and within the interior of the COU at the Site. As such, they may monitor the effects of accelerated actions that have been performed (e.g., source removal and in-situ treatment). Data from these Evaluation wells are therefore appropriate to determine whether monitoring of a particular plume and source area may cease, and provide data to support the determination of whether corresponding groundwater plume treatment systems may be decommissioned. In addition, Evaluation wells are used to support any groundwater evaluations that may be needed as a result of changing contaminant characteristics in downgradient Sentinel and/or AOC wells. Data from these wells also assist evaluations of predictions made through groundwater modeling efforts.

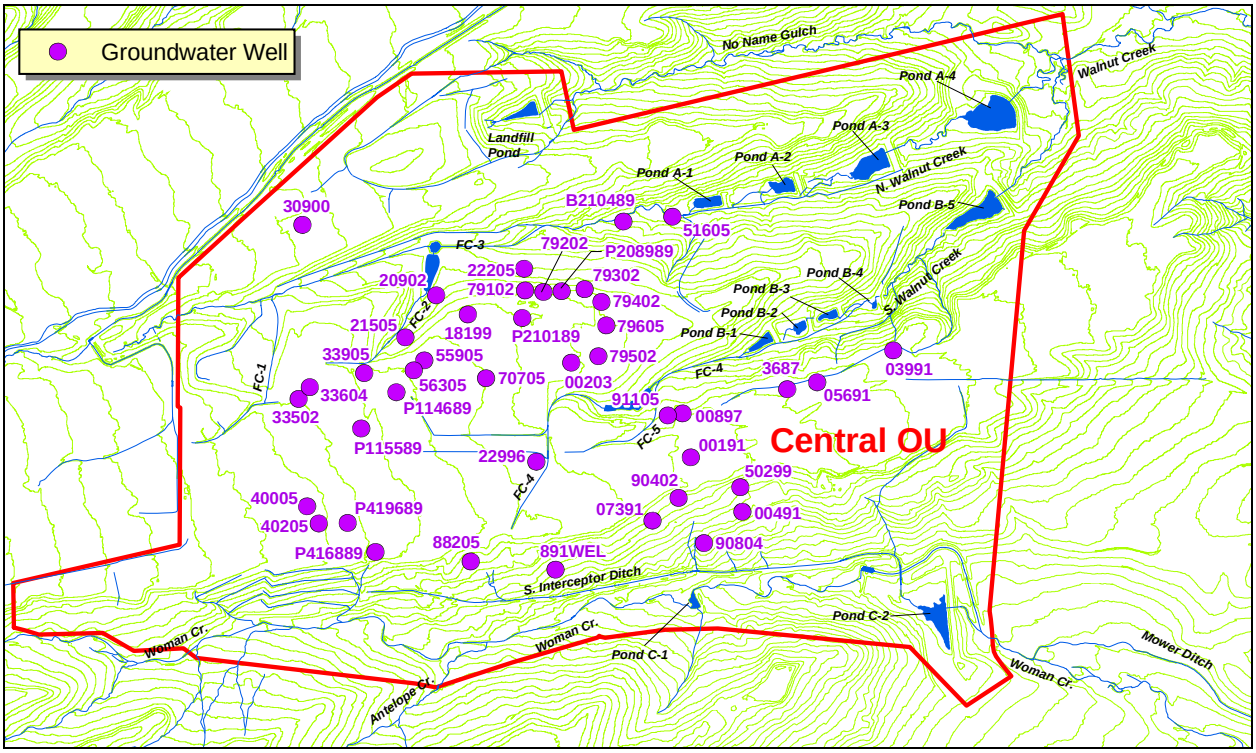


Figure 6–8. Evaluation Well Locations

Data and Sample Collection Protocols

General monitoring information for Evaluation wells is provided in Table 6−16. Sampling frequencies are summarized in Table 6−17.

Table 6−16. Evaluation Wells

Location Code	Location Description	Analytes[a]
00191	East of former 903 Pad area	VOCs
00203	Downgradient (southern) portion of SPP	VOCs, U
00491	Southeast of former 903 Pad area	VOCs
00897	Mound Site source area	VOCs
3687	East Trenches source area	VOCs
03991	East of East Trenches source area	VOCs
05691	East Trenches source area	VOCs
07391	Ryan's Pit source area	VOCs
18199	North of former IHSS 118.1 source area	VOCs
20902	Northwest of former IHSS 118.1 source area	VOCs
21505	West of former B776/777 area	VOCs
22205	Downgradient (northern) portion of SPP	VOCs, U
22996	East/northeastern part of former B886 area	U, nitrate
30900	PU&D Yard Plume source area	VOCs, U, nitrate
33502	Oil Burn Pit #1 source area	VOCs, U, nitrate
33604	Oil Burn Pit #1 source area	VOCs, U, nitrate
33905	North of former 231 Tanks area	VOCs
40005	Western part of former B444 area	VOCs
40205	Southern part of former B444 end	VOCs, U
50299	East of former 903 Pad area	VOCs
51605	Downgradient, adjacent to GS13	VOCs, U
55905	Northern part of former B559 area	VOCs
56305	Western part of former B559 area	VOCs
70705	Eastern part of former B707 area	VOCs
79102	SPP source area - north	VOCs, U, nitrate
79202	SPP source area - north	VOCs, U, nitrate
79302	SPP source area - northeast	U, nitrate
79402	SPP source area - northeast	U, nitrate
79502	SPP source area - east	VOCs, U, nitrate
79605	SPP source area - east	VOCs
88205	Southern part of former B881 area	U, nitrate
891WEL	OU1 Plume source area	U, nitrate
90402	Southeast of former 903 Pad area	VOCs, U
90804	Southeastern part of 903 Pad/Ryan's Pit Plume	VOCs
91105	Oil Burn Pit #2 source area	U, nitrate
B210489	Downgradient of SPPTS	VOCs, U
P210189	SEP-area VOC plume source area	VOCs, U, nitrate
P208989	SPP source area - north	VOCs, U, nitrate
P114689	Southwest of former B559 area	VOCs, U
P115589	Western part of former B551 Warehouse area	VOCs, U
P419689	Southeast of former B444 area	VOCs
P416889	Southeast of former B444 area	VOCs

Notes: [a]Samples for the analysis of U will be field-filtered using a 0.45-micron in-line filter.
Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.

Table 6−17. Sampling Frequency for Evaluation Wells

Sampling Frequency	Timing	Schedule Considerations
Biennial (every 2 years)	Second calendar quarter (high-water conditions)	Attempt to sample with other locations monitoring the same plume(s)/area(s)

Data Evaluation

Analytical data from Evaluation wells are assessed according to the Figure 9 flowchart in RFLMA (Attachment A2). Analytical data evaluation may be performed as data become available, but only need to be reported in the corresponding annual report.

Review of data to determine whether monitoring may cease will be performed as analytical results approach exit requirements. When concentrations in a well exhibit a statistically significant decreasing trend at the 95 percent confidence level, **or** the 85th percentile concentration is less than the corresponding surface water standard or Evaluation well uranium threshold, then conditions will be reviewed with the regulatory agencies to seek approval to exit monitoring by well or analyte suite, as appropriate. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.7 Investigative Monitoring

When reportable water quality measurements are detected by surface water monitoring at POEs or POCs, additional monitoring may be conducted to identify[7] the source and evaluate for mitigating action. Although not required by RFLMA, this investigative monitoring objective is intended to provide upstream water quality information if reportable water quality values are detected at POEs or POCs. Data collection is generally limited to POE and POC analytes and is intended to be discontinued once acceptable water quality has been demonstrated at POEs and POCs for an extended period.

Data collection is currently implemented at the locations shown on Figure 6–9 and described in Table 6−18. The majority of these locations are sampled primarily to satisfy other monitoring objectives, although the data are also used for this investigative objective. The current locations were not chosen in response to a specific source evaluation. They were chosen preemptively as a BMP immediately following completion of the RFP/RFETS Closure Project and are intended to be discontinued under this monitoring objective based on data evaluation. Any future data collection upstream of POEs and POCs, subject to the consultative process, is not limited to the locations on Figure 6–9. The RFLMA parties may also elect to collect data using other methods, subject to the characteristics of the reportable water quality values and through the consultative process.

[7] Note that the term “identify” is used here to mean “locate.” Characterization is also implied.

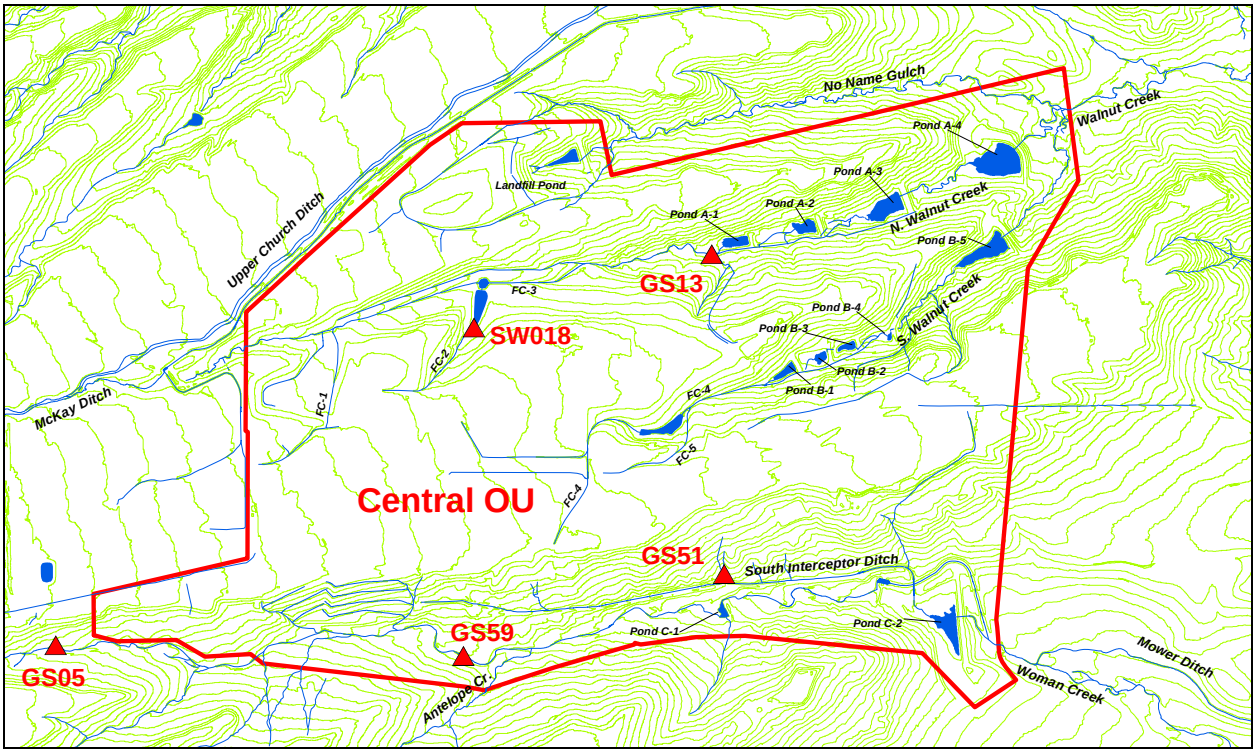


Figure 6–9. Investigative Monitoring Locations

Table 6−18. Investigative Monitoring Locations

Location Code	Location Description	Primary Flow Measurement Device	Telemetry?
GS05	Woman Creek at western Site boundary	9-inch Parshall flume with weir insert	Yes
GS13	North Walnut Creek just upstream of A-Series Bypass	6-inch Parshall flume	Yes
GS51	Drainage area south of 903 Pad/Lip tributary to the SID	0.75-foot H-flume	Yes
GS59	Woman Creek 700 feet east of the OLF	1.5-foot Parshall flume	Yes
SW018	North Walnut Creek tributary west of former B771 area	1-foot H-flume	Yes

Data and Sample Collection Protocols

Details on instrumentation for the five current investigative locations are provided in Table 6−18. Continuous flow and precipitation data are currently collected using automated instrumentation (Table 6−19). Investigative locations currently collect continuous flow-paced composite samples for select analytes (Table 6−20). Table 6−20 also lists the primary monitoring objectives as applicable; these are the objectives required by RFLMA. Although the primary monitoring objective may require fewer samples than specified under this investigative objective, the additional data are expected to also be used under the primary objective. The method used to determine appropriate flow-pacing for composite samples is discussed in Section 8.1.1. Sample scheduling targets are listed in Table 6−21.

Table 6−19. Investigative Field Data Collection: Parameters and Frequency

Location Code	Flow Rate	Precipitation
GS05	15-minute continuous	5-minute continuous
GS13	15-minute continuous	5-minute continuous
GS51	15-minute continuous	NA
GS59	15-minute continuous	5-minute continuous
SW018	15-minute continuous	5-minute continuous

Note: All locations collect both 5- and 15-minute interval flow data. NA = not applicable

Table 6−20. Investigative Sample Collection: Type and Analytes

Location Code	Type[a]	Analytes	Primary Monitoring Objective
GS05	Continuous flow-paced composites[b]	isotopic U[c]	OLF Monitoring
GS13	Continuous flow-paced composites[b]; grabs[d]	isotopic U[c]; nitrate[d]	Groundwater Treatment System Monitoring
GS51	Continuous flow-paced composites	Pu-239,240; Am-241; TSS[e]	Investigative Monitoring
GS59	Continuous flow-paced composites[b]	isotopic U[c]	OLF Monitoring
SW018	Continuous flow-paced composites	Pu-239,240; Am-241; TSS[e]	Investigative Monitoring

Notes: [a]Sample types are defined in Section 8.1.1.
[b]Only grab sampling, not flow-paced sampling, is required by the primary monitoring objective; flow-paced sampling is implemented at these locations for the Investigative objective.
[c]Isotopes U-233,234; U-235; U-238
[d]Nitrate will be collected at GS13 as semiannual grab samples. Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.
[e]Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS hold-time limits.

Table 6−21. Investigative Monitoring Targets (Number of Composite Samples)

Month	Number of Samples				
	GS05	GS13	GS51	GS59	SW018[a]
October	1	1	1	1	1
November	0	0	0	0	1
December	1	1	0	1	0
January	0	1	0	0	1
February	0	1	1	0	0
March	2	1	1	2	1
April	3	2	2	3	1
May	1	1	1	1	1
June	0	0	1	0	1
July	0	0	0	0	1
August	0	0	0	0	0
September	0	0	1	0	0
Annual Total	8	8	8	8	8

Notes: [a]According to Figure 6–10 and through the consultative process, samples collected at SW018 were no longer routinely analyzed starting in FY 2008. Samples at SW018 will continue to be collected and archived for 6 months. If reportable values are subsequently observed at a downstream POE or POC, the archived samples may be analyzed as part of a source evaluation (see Section 9.6) subject to the consultative process.

Based on variability of past monitoring data and to achieve sufficient confidence for decision making, frequency targets for all investigative locations will be eight composites annually. Additionally, no more than three composites per month will be targeted (see Table 6−21).

The sample counts listed in Table 6−21 are targets only. During dry years, it is unlikely the targets will be achieved.

Data Evaluation

Data collected at investigative monitoring locations are evaluated based on their ability to aid in a specific source evaluation. These evaluations include, but are not limited to, loading, fate and transport, correlations and trending, and other statistical evaluations (see Section 9.6 for additional information).

As stated previously, the current locations were not chosen in response to a specific source evaluation. They were chosen preemptively as a BMP immediately following completion of the RFP/RFETS Closure Project and are intended to be discontinued under this monitoring objective based on data evaluation. Decisions regarding the termination of data collection in support of investigative monitoring at the current locations (Figure 6–9) will be made according to the flowchart on Figure 6–10.

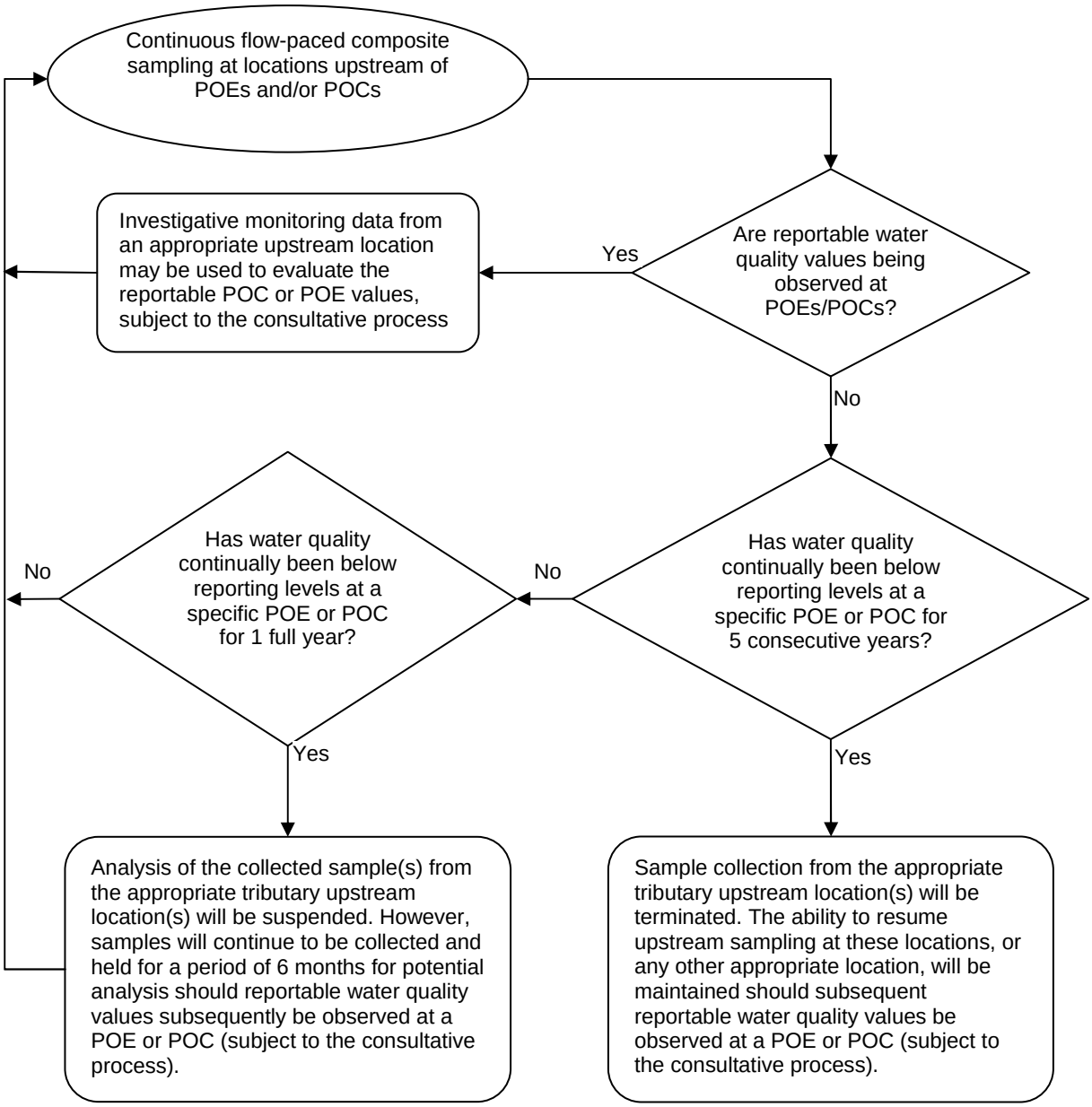
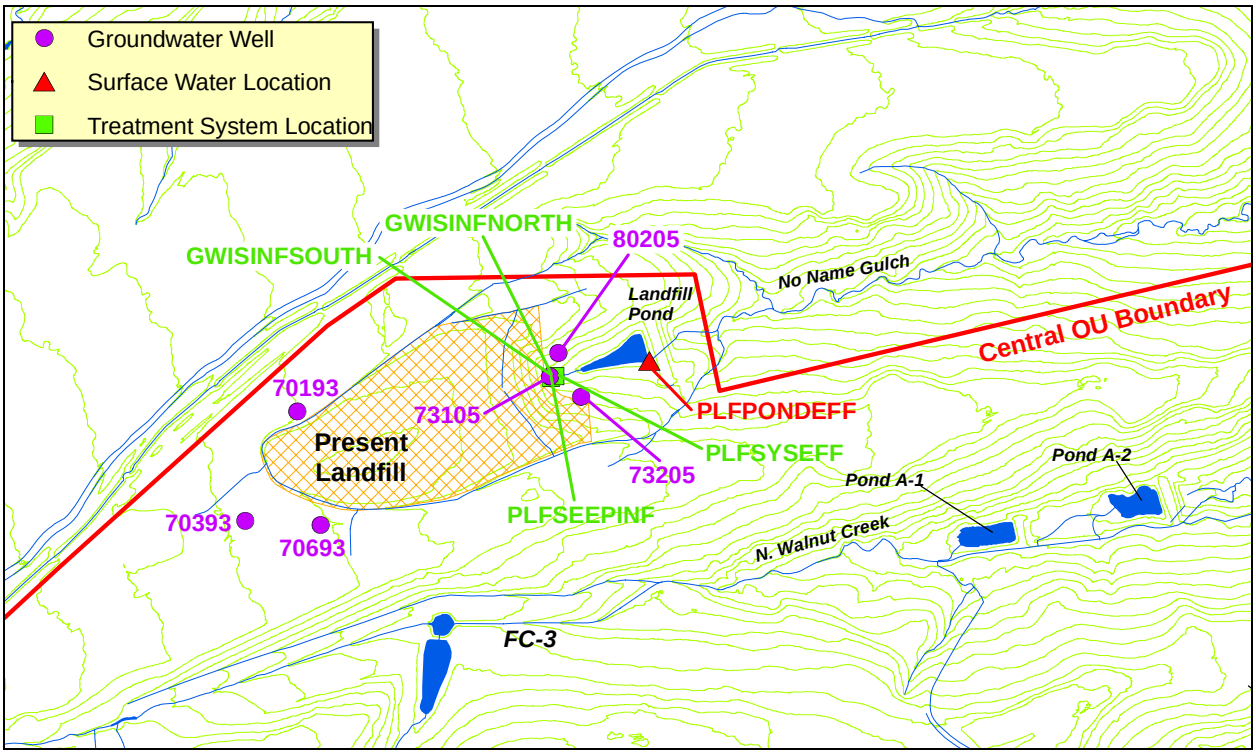


Figure 6–10. Investigative Monitoring Flowchart

6.1.8 PLF Monitoring

This objective deals with monitoring surface water and groundwater at the PLF to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in Appendix B of the *Final Interim Measure/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill* (DOE 2004a) and finalized in the PLF M&M Plan (Attachment D2).

Water monitoring locations for the PLF are shown on Figure 6–11. The surface water and treatment system monitoring requirements that deal specifically with the PLFTS are discussed in detail in Section 6.1.10. Details regarding general groundwater monitoring are provided below.



Note: PLFSYSEFF serves as both the treatment system effluent and performance surface water location. Routine monitoring of GWISINFNORTH and GWISINFSOUTH has been discontinued as of FY 2008.

Figure 6–11. PLF Monitoring Locations

Data and Sample Collection Protocols

Monitoring wells supporting the PLF are classified as RCRA wells. Three of these wells are located upgradient of the landfill, and three are downgradient of the landfill but upgradient of the Landfill Pond. This network and the monitoring requirements are specified in the PLF M&M Plan (Attachment D2). Prior to late 2005 when this network was finalized, a different set of monitoring wells comprised the RCRA network for the PLF. As a result of this change, data from the current network cannot be compared accurately against data from the older network. Additional monitoring wells are present in the general vicinity of the PLF; however, they do not contribute to the RCRA monitoring of the facility and therefore are addressed elsewhere.

General monitoring information for the RCRA wells at the PLF is provided in Table 6−22. Sampling frequencies are summarized in Table 6−23.

Table 6−22. RCRA Monitoring Wells at the PLF

Location Code	Location Description	Analytes[a]
70193	Upgradient (northwest) of the upgradient end of the PLF	VOCs, metals
70393	Upgradient (west/southwest) of the upgradient end of the PLF	VOCs, metals
70693	Upgradient (southwest) of the upgradient end of the PLF	VOCs, metals
73005	Downgradient (northeast) of the downgradient end of the PLF	VOCs, metals
73105	Downgradient (east) of the downgradient end of the PLF at the PLFTS	VOCs, metals
73205	Downgradient (southeast) of the downgradient end of the PLF	VOCs, metals

Notes: [a]Samples for the analysis of metals will be field-filtered using a 0.45-micron in-line filter.
Laboratory analytes and analytical methods are limited to those listed in the PLF M&M Plan (Attachment D2).

Table 6−23. Sampling Frequency for RCRA Wells at the PLF

Sampling Frequency	Timing	Schedule Considerations
Quarterly	Each calendar quarter	Attempt to sample all RCRA wells at the PLF as a group; if possible, also sample other PLF-area wells at the same time

Data Evaluation

Analytical data from RCRA wells at the PLF are assessed according to the Figure 10 flowchart in RFLMA (Attachment A2). Because similar rules guide the use of data at the OLF RCRA wells, this figure applies to both sets of RCRA wells.

Groundwater analytical data are generally reviewed as they become available and are formally evaluated annually. As shown on the Figure 10 flowchart in RFLMA (Attachment A2), this evaluation is designed to assess whether mean concentrations in downgradient wells are statistically different from those in upgradient wells, and whether concentrations show a significant increasing trend.

Review of data to determine whether monitoring may cease will be performed as described on the Figure 10 flowchart in RFLMA (Attachment A2) and will be based on the two previous periodic reviews. If the 85th percentile concentrations in each downgradient well are less than or equal to the applicable standards and indicate an indeterminate or decreasing trend at the 95 percent confidence level, termination of monitoring will be sought in discussions with the regulatory agencies. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.9 OLF Monitoring

This objective deals with monitoring surface water and groundwater at the OLF to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in the *Draft Final IM/IRA of IHSS Group SW-2, IHSS 115, Original Landfill and IHSS 196, Filter*

Backwash Pond, Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations (DOE 2004b). They were finalized in the OLF M&M Plan (Attachment D1). Water monitoring locations for the OLF are shown on Figure 6–12.

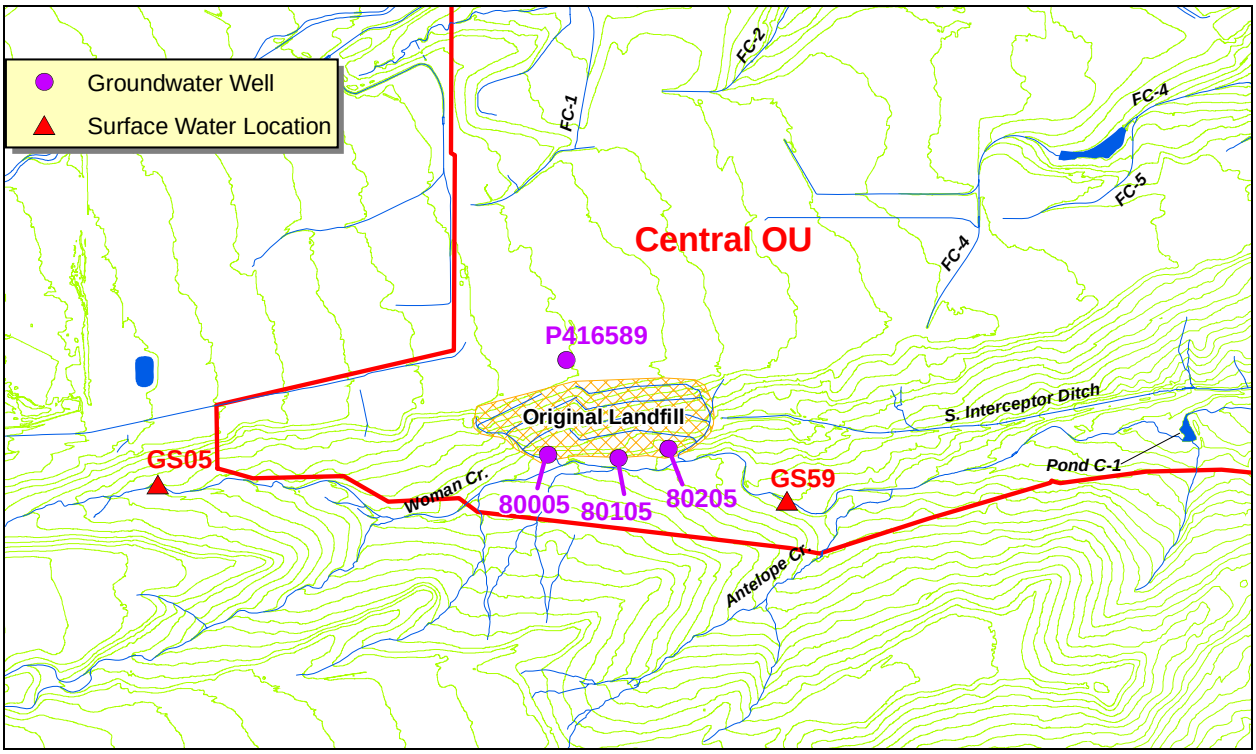


Figure 6–12. OLF Monitoring Locations

Data and Sample Collection Protocols

Surface water in Woman Creek will be sampled both upstream (GS05) and downstream (GS59) of the OLF (Table 6−24). Table 6−25 presents a list of the analytes sampled for as part of the OLF surface water sampling.

Table 6−24. OLF Surface Water Monitoring Locations

Location Code	Location Description	Primary Flow Measurement Device	Telemetry?
GS05 (upstream)	Woman Creek at western Site boundary	9-inch Parshall flume with weir insert	Yes
GS59 (downstream)	Woman Creek 700 feet east of the OLF	1.5-foot Parshall flume	Yes

Table 6−25. OLF Surface Water Sample Collection: Type and Analytes

Location Code	Type	Frequency	Analytes[a]
GS05	Grabs[b]	Quarterly[b]	isotopic U[c]; total and dissolved metals; VOCs
GS59	Grabs[b]	Quarterly[b]	isotopic U[c]; total and dissolved metals; VOCs

Notes: [a]Laboratory analytes and analytical methods are limited to those listed in the OLF M&M Plan (Attachment D1).
[b]Quarterly grabs are the minimum requirement to meet the monitoring objective. Since automated samplers and flow measurement devices were in place at the end of closure, the current sampling consists of eight flow-paced composites collected annually (for uranium and metals). It is expected that sampling will gradually be reduced to the minimum requirement over time, subject to the consultative process.
[c]Isotopes U-233,234; U-235; U-238

Because complying with RCRA is an applicable or relevant and appropriate requirement (ARAR) at the OLF, the monitoring wells supporting the OLF are classified as RCRA wells. One is located upgradient of the landfill, and three are downgradient of the landfill but upgradient of Woman Creek. This network and the monitoring requirements are specified in the OLF M&M Plan (Attachment D1). Although earlier groundwater data exist for the OLF, RCRA monitoring at the landfill was not performed prior to late 2005 when this network was finalized. Likewise, although additional monitoring wells are present in the general vicinity of the OLF, they do not contribute to the RCRA monitoring and are addressed elsewhere.

General monitoring information for RCRA wells at the OLF is provided in Table 6−26. Sampling frequencies are summarized in Table 6−27.

Table 6−26. RCRA Monitoring Wells at the OLF

Location Code	Location Description	Analytes[a]
P416589	Upgradient (north) of the OLF	VOCs, SVOCs, metals
80005	Downgradient (south) of the western portion of the OLF	VOCs, SVOCs, metals
80105	Downgradient (south) of the central portion of the OLF	VOCs, SVOCs, metals
80205	Downgradient (south) of the eastern portion of the OLF	VOCs, SVOCs, metals

Notes: [a]Samples for the analysis of metals will be field-filtered using a 0.45-micron in-line filter.
Laboratory analytes and analytical methods are limited to those listed in the OLF M&M Plan (Attachment D1).
SVOC = semivolatile organic compound

Table 6−27. Sampling Frequency for RCRA Wells at the OLF

Sampling Frequency	Timing	Schedule Considerations
Quarterly	Each calendar quarter	Attempt to sample all RCRA wells at the OLF as a group; if possible, also sample other OLF-area wells at the same time

Data Evaluation

Compliance with surface water quality standards at the OLF is demonstrated by the Figure 12 flowchart in RFLMA (Attachment A2). Generally, surface water analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical

result is higher than the standard for a particular analyte, then the compliance values are calculated immediately. If the compliance values suggest initiation of the consultative process, then validation is requested for all data packages used in the calculation.

Analytical data for RCRA wells at the OLF are assessed according to the Figure 10 flowchart in RFLMA (Attachment A2). Because similar rules guide the use of data at the PLF RCRA wells, this figure applies to both sets of RCRA wells.

Groundwater analytical data are generally reviewed as they become available, and are formally evaluated annually. As shown on the Figure 10 flowchart in RFLMA (Attachment A2), this evaluation is designed to assess whether mean concentrations in downgradient wells are statistically different from those in upgradient wells, and whether downgradient concentrations show a significant increasing trend and the 85th percentile concentration is above the applicable standard. This latter component of the comparison is modeled after the statistical evaluation of Sentinel well data; see the Figure 10 flowchart in RFLMA (Attachment A2) for the associated data evaluation process.

Groundwater data will be reviewed, as described on the Figure 10 flowchart in RFLMA (Attachment A2), to determine whether monitoring may cease. This review will be based on the results of upgradient/downgradient water quality comparisons, 85th percentile concentrations in each downgradient well, and trending. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.1.10 Groundwater Treatment System Monitoring

Contaminated groundwater is intercepted and treated in four areas of the Site. Three of the treatment systems (MSPTS, ETPTS, and SPPTS) include a groundwater intercept trench (collection trench), which is similar to a French drain with an impermeable membrane on the downgradient side. Groundwater entering the trench is routed through a drain pipe into one or more treatment cells, where it is treated and then discharged to surface water. The fourth system (PLFTS) treats water from the north and south components of the GWIS and flow from the PLF Seep.

The MSPTS was installed in 1998, the ETPTS and SPPTS were installed in 1999, and the PLFTS was installed in 2005. Improvements to the SPPTS were installed in 2008, and additional improvements are planned for 2009 and beyond. Additional information on these systems is provided below and in the O&M Manual for Groundwater Treatment Systems (Attachment C1). Although additional information for these systems is available in many documents, the following original decision documents may be most helpful:

- *Final Mound Site Plume Decision Document* (DOE 1997);
- *Final Proposed Action Memorandum for the East Trenches Plume* (DOE 1999a);
- *Final Solar Ponds Plume Decision Document* (DOE 1999b); and
- PLF M&M Plan (Attachment D2).

Water monitoring for the MSPTS, ETPTS, and SPPTS includes a minimum of three sample collection points each: untreated influent entering the treatment system, treated effluent exiting

the system, and a surface water performance location. At the PLFTS, the treated effluent and surface water sampling locations are typically the same; this is discussed in further detail below.

The fundamental questions at each system are whether (1) influent water quality indicates treatment is still necessary, (2) effluent water quality indicates system maintenance is required, and (3) surface water quality suggests impacts from inadequate treatment of influent.

Mound Site Plume Treatment System

As noted above, the MSPTS was installed in 1998; it was the first such system at the Site. Because components of this passive treatment system represented new technology at the time, EPA partially funded its installation. VOC-contaminated groundwater collects in the intercept trench and is piped to treatment cells filled with zero-valent iron (ZVI), which treats the VOCs by means of reductive dechlorination. Because this system experienced a significant change in 2005 in the amount of water it receives, the following information is included to provide additional background.

The MSPTS was originally designed to intercept and treat a plume of contaminated groundwater migrating toward South Walnut Creek from the Mound Site (also referred to simply as the Mound and designated as IHSS 113), from which contaminated soils were removed in 1997 (Figure 6–13). Since 2005, the MSPTS also intercepts and treats contaminated groundwater from Oil Burn Pit #2 (IHSS 153) as it migrates toward South Walnut Creek. Contaminated soil was removed from Oil Burn Pit #2 in 2005. Groundwater at both of these source areas is monitored using Evaluation wells (well 00897 for the Mound, 91105 for Oil Burn Pit #2).

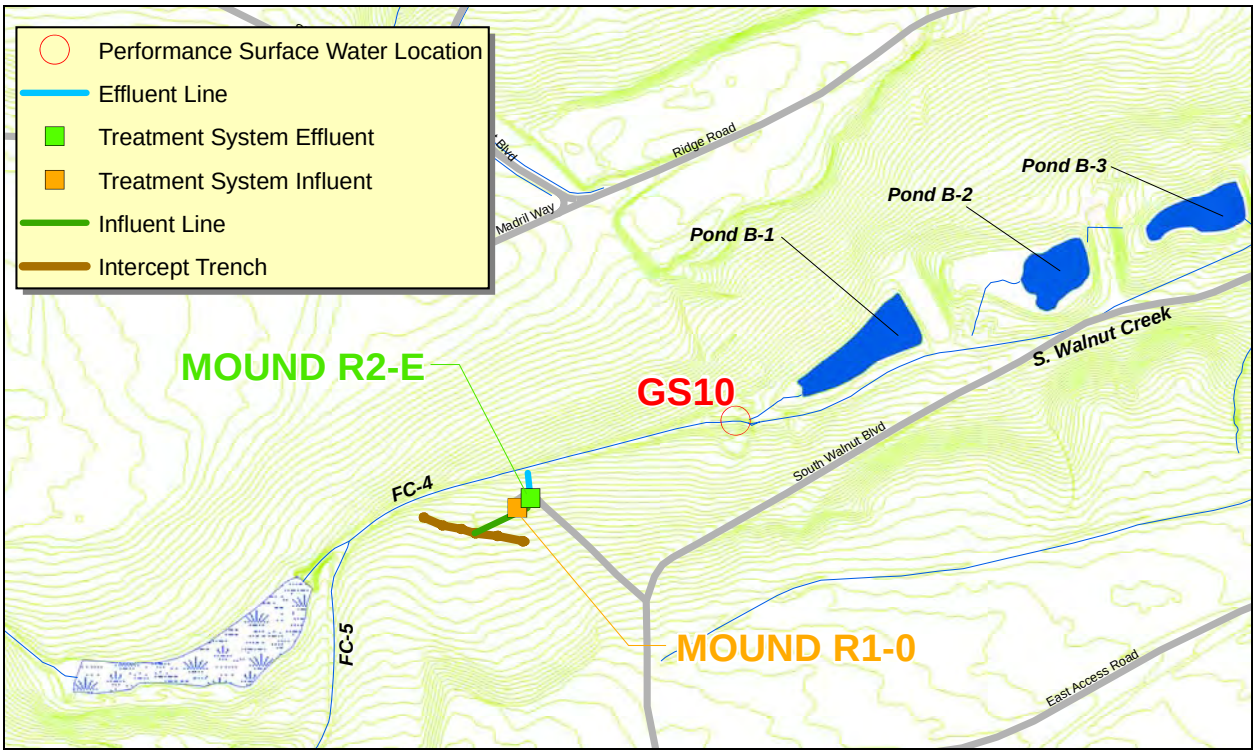


Figure 6–13. MSPTS Monitoring Locations

During Site closure efforts in 2005, a 72-inch storm drain that extended north from the area of Oil Burn Pit #2 to South Walnut Creek was removed. To address the potential for contaminants discharging to South Walnut Creek via the preferential flow path represented by the remaining backfilled trench, a gravel drain was installed to divert groundwater from this trench to the MSPTS intercept trench. Influent to the MSPTS increased by roughly an order of magnitude following this activity, from approximately 0.1 to 0.2 gallon per minute (gpm) or less to slightly more than 1.0 gpm. It has since decreased to approximately 0.6 to 0.7 gpm, based on data for 2007.

Shortly after this linkage was formed, the MSPTS effluent water quality degraded. Constituents such as tetrachloroethene, trichloroethene, and cis-1,2-dichloroethene were detected in the effluent, and concentrations appeared to be increasing (DOE 2006c). Simultaneously, crusting and solidification of the ZVI in the cells significantly decreased media permeability. The MSPTS media was replaced in summer 2006 to address the decrease in treatment effectiveness. At the same time, additional automated instrumentation was installed to support O&M of the system by allowing Site personnel to optimize the performance of the treatment cells, thereby reducing the frequency of costly ZVI replacements. For additional information on system maintenance and operation, refer to the O&M Manual for Groundwater Treatment Systems (Attachment C1).

Data and Sample Collection Protocols

Monitoring locations specific to the MSPTS are displayed on Figure 6–13. General monitoring information for these locations is provided in Table 6−28. Sampling frequencies are summarized in Table 6−29. In addition to the monitoring locations shown, several piezometers are present within the collection trench. Although these are no longer routinely monitored, they are retained for troubleshooting purposes as described in the O&M Manual for Groundwater Treatment Systems (Attachment C1).

Table 6−28. MSPTS Sampling Locations

Location Code	Location Description	Analytes[a]
Mound R1-0	Influent sampling location	VOCs
Mound R2-E	Effluent sampling location	VOCs
GS10	Downgradient surface water performance location	VOCs

Notes: [a]Samples for the analysis of VOCs at all of the above locations will be collected as grab samples. Other required GS10 monitoring objectives and samples are not addressed here.

Table 6−29. Sampling Frequency for MSPTS Sampling Locations

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample all MSPTS-area locations as a group

Data Evaluation

The data evaluation process guiding the use of analytical data for the MSPTS locations is shown on the Figure 11 flowchart in RFLMA (Attachment A2). Because similar rules guide the use of data at the ETPTS, SPPTS, and PLFTS, this figure applies to those systems as well.

Compliance with surface water quality standards (Table 1 of Attachment 2 to RFLMA) at the MSPTS is demonstrated by the Figure 11 flowchart in RFLMA. Generally, analytical data evaluation is performed as data become available. This is particularly important for VOC data from performance location GS10, as described below. If the data suggest additional system maintenance is required, additional inspections and data collection are performed to confirm and support this issue. Data are reported in the corresponding quarterly report and evaluated in the annual report.

In addition to the increase in flows, influent water quality also changed significantly following connection of the Oil Burn Pit #2 pathway to the MSPTS intercept trench. Residual contamination in the Oil Burn Pit #2 source area was addressed during the accelerated action at that location via the addition of HRC® to the excavation backfill. As a result, degradation byproducts are seen at markedly higher concentrations in MSPTS influent than was the case prior to the connection with the Oil Burn Pit #2 pathway. Some of these byproducts are recalcitrant and resist complete removal via ZVI treatment, which can result in their detection in treated effluent. Consultation on this subject with CDPHE was held in 2008; the conclusion at that time was that as long as surface water performance samples continue to show water quality meets RFLMA Table 1 standards, no action beyond continued monitoring and evaluation is required. Therefore, prompt review of GS10 VOC data is warranted, and regular communication with the lead regulatory agency is important to ensure awareness of current conditions.

The determination of whether the MSPTS may be closed is made using influent water quality data and in consultation with the regulatory agencies. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

East Trenches Plume Treatment System

The ETPTS treated an annual average of approximately 1.8 gpm in 2007; however, previous annual averages have ranged from approximately 1 to 4 gpm. This system was installed in 1999. It is modeled after the MSPTS and consists of a groundwater intercept trench that collects and diverts VOC-contaminated groundwater to cells containing ZVI, which treats the water (Figure 6–14). Completion of the groundwater intercept trench was difficult because of repeated sloughing of the trench sides, particularly where the trench intersects the basal Arapahoe Formation sandstone. Since installation, the ETPTS has required more frequent ZVI replacement than originally anticipated due to reduced permeability of the iron caused by the media becoming clogged with mineral precipitates. Following completion of the RFP/RFETS Closure Project and transfer of operations to DOE-LM, additional automated instrumentation was installed at the ETPTS. This instrumentation is intended to support the O&M of this system by allowing Site personnel to optimize the performance of the treatment cells, thereby reducing the frequency of costly ZVI replacements. For additional information on system maintenance and operation, refer to the O&M Manual for Groundwater Treatment Systems (Attachment C1).

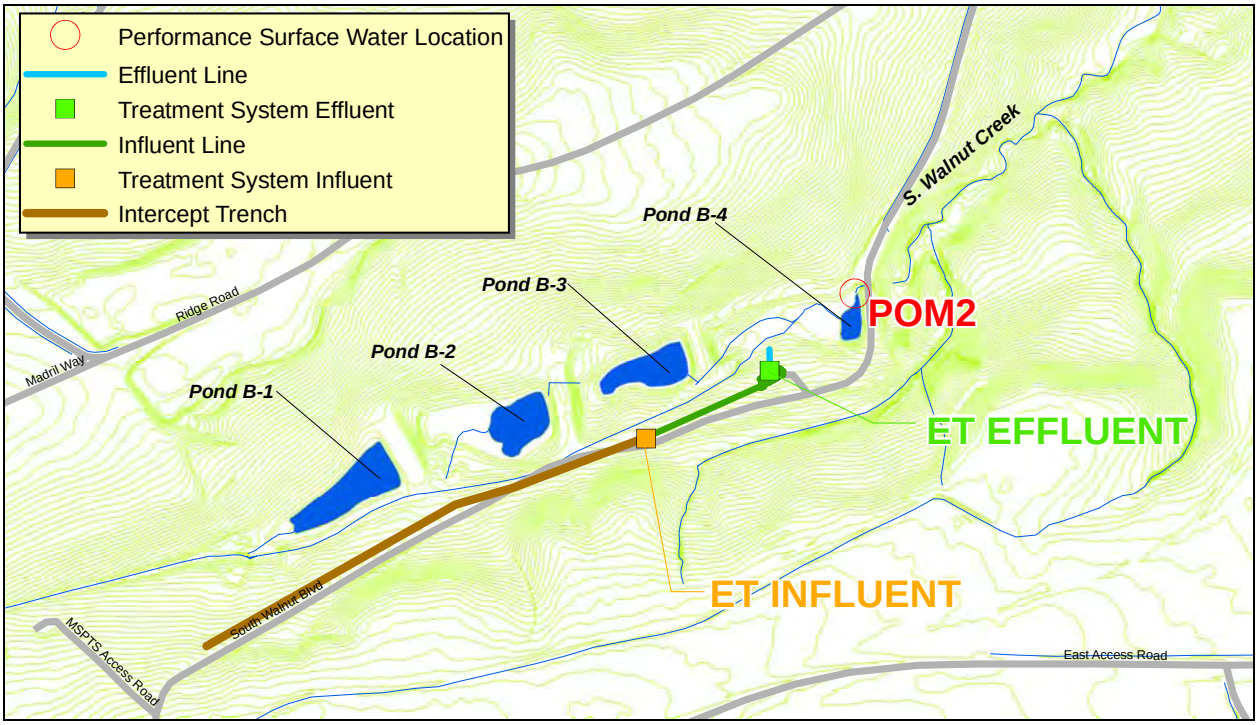


Figure 6–14. ETPTS Monitoring Locations

Data and Sample Collection Protocols

Monitoring locations specific to the ETPTS are displayed on Figure 6–14. General monitoring information for these locations is provided in Table 6−30. Sampling frequencies are summarized in Table 6−31. In addition to the monitoring locations shown, several piezometers are present within the collection trench. Although these are no longer routinely monitored, they are retained for troubleshooting purposes as described in the O&M Manual for Groundwater Treatment Systems (Attachment C1).

Table 6−30. ETPTS Sampling Locations

Location Code	Location Description	Analytes[a]
ET INFLUENT	Influent sampling location	VOCs
ET EFFLUENT	Effluent sampling location	VOCs
POM2[b]	Downgradient surface water performance location	VOCs

Notes: [a]Samples for the analysis of VOCs at all of the above locations will be collected as grab samples.
[b]The original POM2 location will be destroyed during the breaching of Dam B-4, and a replacement location will be established. All sampling and data evaluation requirements associated with POM2, including decisions, will apply equally to the new location. See text for additional discussion.

Table 6−31. Sampling Frequency for ETPTS Sampling Locations

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample all ETPTS-area locations as a group

Data Evaluation

The data evaluation process guiding the use of analytical data from ETPTS locations is shown on the Figure 11 flowchart in RFLMA (Attachment A2). Because similar rules guide the use of data at the MSPTS, SPPTS, and PLFTS, this figure applies to those systems as well.

Compliance with surface water quality standards (Table 1 of Attachment 2 to RFLMA) at the ETPTS is demonstrated by the Figure 11 flowchart in RFLMA. Generally, analytical data evaluation is performed as data become available. If the data suggest additional system maintenance is required, additional inspections and data collection are performed to confirm and support this issue. Data are reported in the corresponding quarterly report and are evaluated in the annual report.

As with the MSPTS, VOCs may be detected in ETPTS effluent, a condition that was discussed with CDPHE in 2008. The conclusion at that time was that as long as surface water performance samples continue to show water quality meets RFLMA Table 1 standards, no action beyond continued monitoring and evaluation is required. Prompt review of POM2 VOC data is therefore warranted, and regular communication with the lead regulatory agency is important to ensure awareness of current conditions.

In FY 2009, the dams for Ponds B-1, B-2, B-3, and B-4 (as well as several in the A-series) will be breached. This should not affect operation of the ETPTS, but will require replacement of POM2 given that the original location will be within the footprint of the construction activities. As with the replacement of any required monitoring location, CDPHE will be consulted in advance of establishing the replacement location to ensure it is acceptable. Once POM2 is replaced, the new location will satisfy the requirements of and be evaluated as the surface water performance location for the ETPTS. The next revision of the RFSOG will update this location identification and placement on Figure 6–14, as necessary.

The determination of whether the ETPTS may be closed is made using influent water quality data and in consultation with the regulatory agencies. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

Solar Ponds Plume Treatment System

The SPPTS was installed in 1999 to treat elevated concentrations of nitrate and uranium in groundwater (Figure 6–15). The media in this system includes one cell containing sawdust and ZVI, and a second containing gravel and ZVI.

Until late 2008, treated effluent from the system was routed through a perforated line remaining from the older (circa 1980) Intercept Trench System (ITS) and discharged to the subsurface. This is why samples collected from the discharge area prior to October 2008 showed elevated nitrate and uranium levels even though the system effluent itself was adequately treated. In September and October 2008, Phase I upgrades to the SPPTS were completed: a sump (the Intercept Trench System Sump [ITSS]) was installed that collects the untreated water from the ITS remnants that are downgradient of the system. This water is then pumped to the system for treatment. Additionally, a new effluent line (i.e., nonperforated) was installed so that treated water is not recontaminated by being commingled with ITS water before discharge. Since these

improvements were completed, the quality of the water that is discharged is very similar to system effluent.

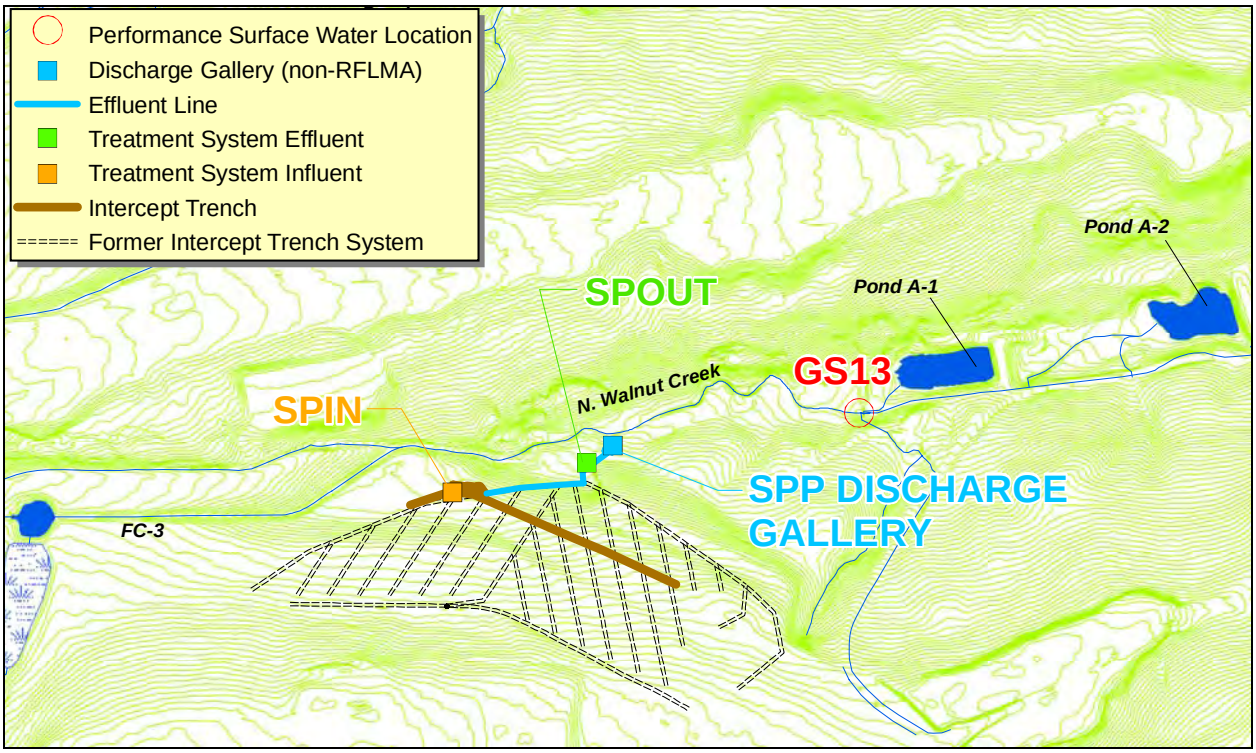


Figure 6–15. SPPTS Monitoring Locations

Flow through the SPPTS has historically varied from 0 gpm (no flow) to at least 7 gpm; annual averages are under 1 gpm (the average for 2007 was approximately 0.5 gpm). Based on the first 2 months of data since completion of the Phase I upgrades, addition of water from the ITSS has roughly doubled the flow through the SPPTS (which averaged approximately 0.8 gpm through the end of 2008) and doubled to tripled concentrations of nitrate in the influent, while simultaneously increasing concentrations of uranium in system influent by about one-half. Spring conditions (higher flow rates) are expected to increase the flow to the system much more. These conditions have reduced the hydraulic residence time within the system, compromising the ability of the existing treatment media to reduce contaminants to target levels. Possible methods of improving treatment in the short term are under consideration.

For the longer term, Phase II improvements (scheduled for spring 2009) will include a new uranium treatment cell that will be installed as the first treatment cell (so that future nitrate treatment media will not be considered radioactive waste). Pilot-scale testing of alternative nitrate treatment media will be conducted as Phase III, and a full-scale overhaul of the nitrate treatment cell (Phase IV) will be evaluated based on the results of Phase III.

When this RFSOG is updated in FY 2010, the text addressing the SPPTS will be updated to reflect changes to the system that will have been made to date. Changes will also be made to the O&M Manual for Groundwater Treatment Systems (Attachment C1), which has been updated

for this version of the RFSOG to reflect the Phase I improvements. Refer to that document for additional information on system maintenance.

Data and Sample Collection Protocols

Monitoring locations specific to the SPPTS are presented on Figure 6–15. General monitoring information for these locations is provided in Table 6−32. Sampling frequencies are summarized in Table 6−33. In addition to the monitoring locations, several piezometers were installed within the collection trench. Although these are no longer routinely monitored, they are retained for troubleshooting purposes as described in the O&M Manual for Groundwater Treatment Systems (Attachment C1). Note that the effluent monitoring point was revised as a result of the Phase I improvements; this change will be made to RFLMA along with several other changes, as noted elsewhere.

Table 6−32. SPPTS Sampling Locations

Location Code	Location Description	Analytes[a]
SPIN	Influent sampling location	U, nitrate
SPOUT[b]	Effluent sampling location	U, nitrate
SPP Discharge Gallery[c]	Pooled effluent above buried Discharge Gallery	U, nitrate
GS13[d]	Downgradient surface water performance location	U, nitrate

Notes: [a]Influent and effluent samples for the analysis of U will be filtered in the field using a 0.45-micron in-line filter. Nitrate is analyzed as nitrate+nitrite as N; this result is conservatively compared to the nitrate standard only.
[b]Effluent samples are collected at SPOUT, which is located in the battery vault by the ITSS, rather than from SPPMM01 in the manhole adjacent to the treatment cells.
[c]The RFLMA does not require sampling of the SPP Discharge Gallery. However, DOE has agreed to continue to monitor this location as requested by downstream communities.
[d]Samples collected for U at GS13 will typically be flow-paced, unfiltered, and analyzed for U isotopes; however, if desired they may be collected as grab samples and filtered consistent with influent and effluent collection methods. U data at GS13 support other monitoring objectives that are not addressed here.

Table 6−33. Sampling Frequency for SPPTS Sampling Locations

Sampling Frequency	Timing	Schedule Considerations
Semiannual	Second and fourth calendar quarters (high- and low-water conditions, respectively)	Attempt to sample all SPPTS-area locations as a group

Data Evaluation

The data evaluation process guiding the use of analytical data from SPPTS locations is shown on the Figure 11 flowchart in RFLMA (Attachment A2). Because similar rules guide the use of data at the MSPTS, ETPTS, and PLFTS, this figure applies to those systems as well.

Compliance with surface water quality standards (Table 1 of Attachment 2 to RFLMA) at the SPPTS is demonstrated by the Figure 11 flowchart in RFLMA. Generally, analytical data evaluation is performed as data become available. If the data suggest additional system maintenance is required, additional inspections and data collection are performed to confirm and

support this issue. Data are reported in the corresponding quarterly report and are evaluated in the annual report.

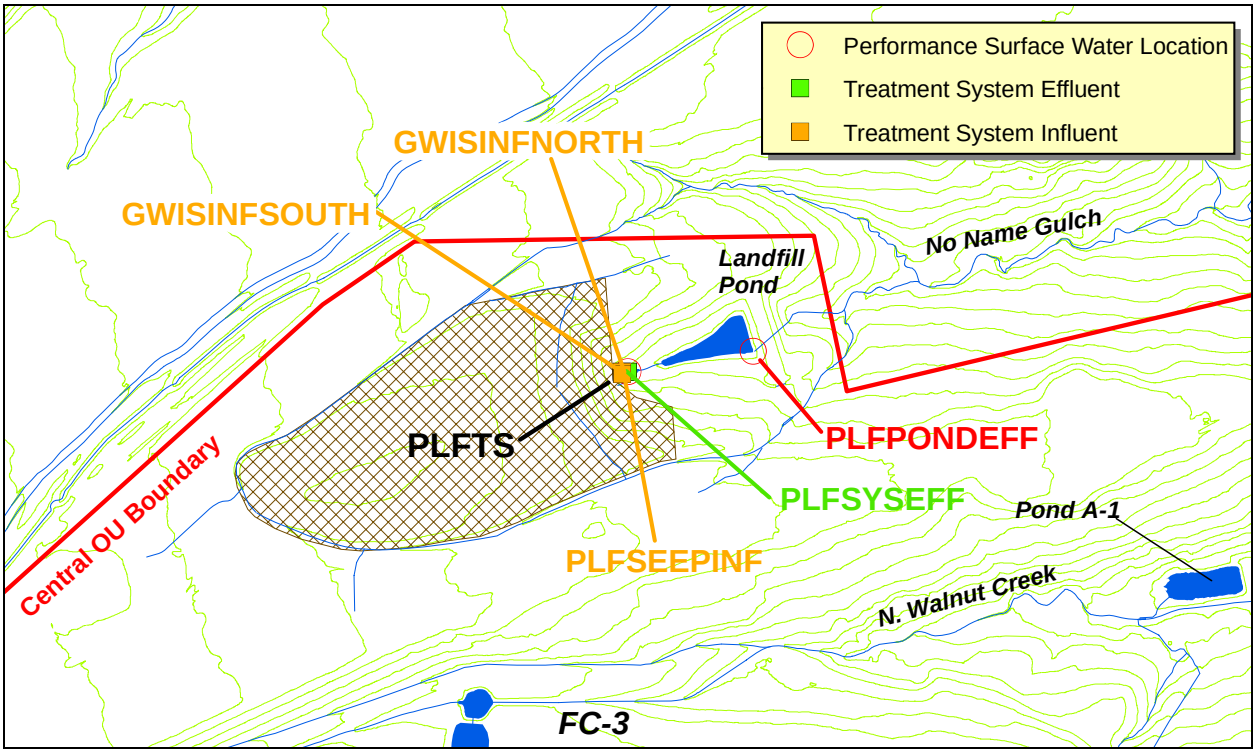
Because the SPP Discharge Gallery is not a RFLMA monitoring location, there are no data evaluation requirements associated with this location. For convenience, water quality at this location is assessed in the same manner as the other locations; however, results of this evaluation do not force any decisions.

The determination of whether the SPPTS may be closed is made using influent water quality data and in consultation with the regulatory agencies. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

Present Landfill Treatment System

This objective deals with monitoring the PLFTS to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in the *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations (DOE 2004a), and finalized in the PLF M&M Plan (Attachment D2).

Water monitoring locations for the PLFTS and sampling location details are shown on Figure 6–16 and Figure 6–17. Groundwater monitoring for the PLF is discussed in detail in the section above. Details regarding PLFTS monitoring are provided below.



Note: PLFSYSEFF serves as both the treatment system effluent and a performance surface water monitoring location. Routine monitoring of GWISINFNORTH and GWISINFSOUTH has been discontinued as of FY 2008.

Figure 6–16. PLFTS Monitoring Locations

Data and Sample Collection Protocols

The PLFTS is routinely sampled at the treatment system influent and effluent sampling location (National Pollutant Discharge Elimination System [NPDES] outfall (Table 6−34 and Table 6−35). Routine sampling of GWISINFNORTH and GWISINFSOUTH has been discontinued but is included in the evaluations required in RFLMA Attachment 2, Figure 11. These sampling locations may be used for investigation purposes. Additional monitoring detail is included in the PLF M&M Plan (Attachment D2).

Table 6−34. PLFTS Water Monitoring Locations

Location Code	Location Description
PLFSEEPINF	Seep influent to treatment system
GWISINFNORTH	North GWIS influent to treatment system (discontinued)
GWISINFSOUTH	South GWIS influent to treatment system (discontinued)
PLFSYSEFF	PLFTS effluent
PLFPONDEFF	Landfill Pond water near pond discharge location (eastern end)

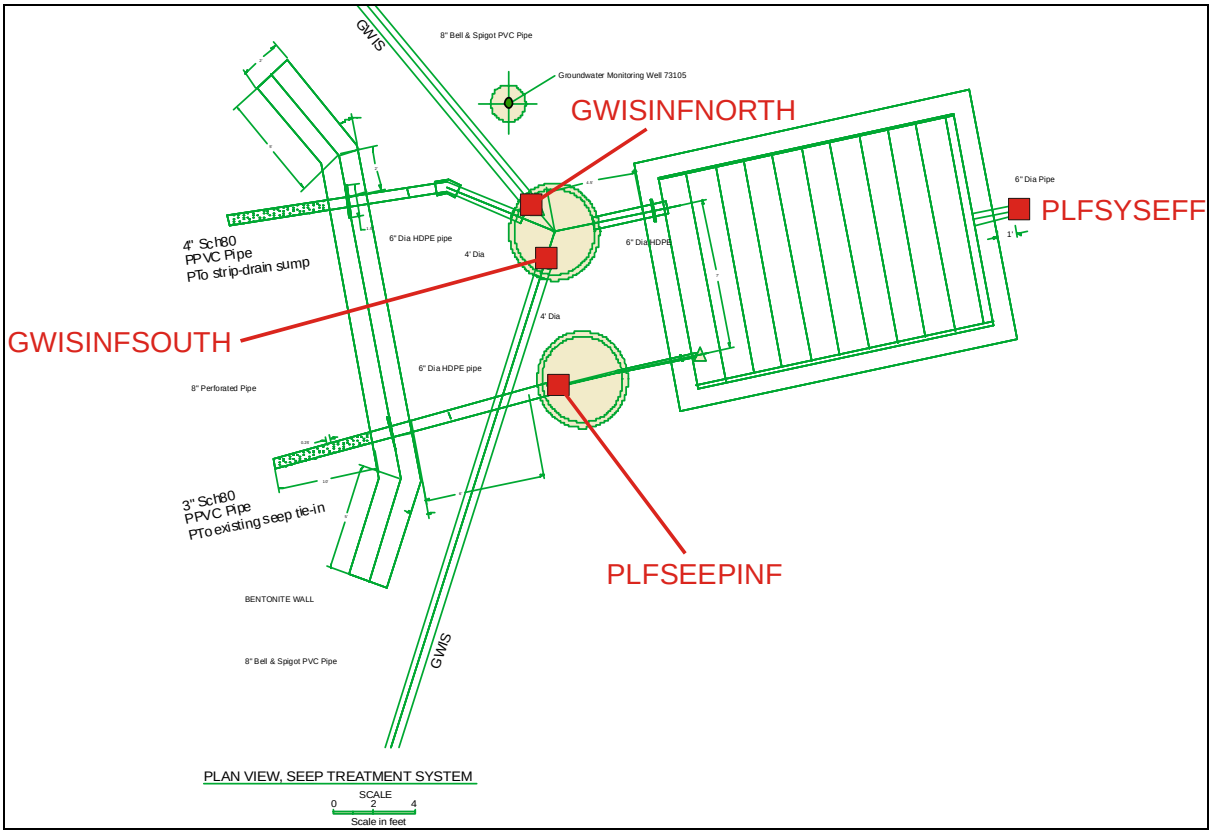


Figure 6–17. PLFTS Sampling Locations (Detail)

Table 6−35. PLFTS Sample Collection: Type and Analytes

Location Code	Type	Frequency	Analytes[a]
PLFSEEPINF	Grab	Quarterly	Isotopic U[b]; total and dissolved metals; VOCs; manual flow measurement (field)
GWISINFNORTH[c]	Grab	Discontinued	NA
GWISINFSOUTH[c]	Grab	Discontinued	NA
PLFSYSEFF	Grab	Quarterly; monthly by decision[d]	Isotopic U[b]; total and dissolved metals; VOCs; SVOCs
PLFPONDEFF	Grab	Determined by decision[d]	Determined by decision[d]

Notes: [a]Laboratory analytes and analytical methods are limited to those listed in the PLF M&M Plan (Attachment D2). Nitrate is analyzed as nitrate+nitrite; the nitrate+nitrite result is conservatively compared to the nitrate standard only.
[b]Isotopes U-233,234; U-235; U-238
[c]According to the Figure 11 flowchart in RFLMA (Attachment A2) and through the consultative process, samples are no longer being collected from the GWIS as of FY 2008.
[d]Refer to the decision logic on the Figure 11 flowchart in RFLMA (Attachment A2).

Data Evaluation

Compliance with surface water quality standards (Table 1 of Attachment 2 to RFLMA) at the PLFTS is demonstrated by the Figure 11 flowchart in RFLMA. Because similar rules guide the use of data at the MSPTS, ETPTS, and SPPTS, this figure applies to those systems as well.

Generally, analytical data evaluation is performed as data become available. If an initial qualitative screening indicates an analytical result is higher than the standard for a particular analyte, then the compliance values are calculated immediately. If the compliance values suggest initiation of the consultative process, then validation is requested for all data packages used in the calculation.

The determination of whether the PLFTS may be closed is made using influent water quality data and in consultation with the regulatory agencies. Once monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required. The decision to end monitoring at the PLFTS will be documented in a RFLMA Contact Record and incorporated into Attachment 2 to RFLMA during the next revision of RFLMA. The PLF M&M Plan (Attachment D2) would also need to be modified to reflect the end of operation of the treatment system.

6.1.11 Pre-Discharge Monitoring

This monitoring objective deals with pre-discharge sampling of Ponds A-4, B-5, and C-2, or any other upstream pond functioning as a terminal pond, as a BMP to indicate compliance with surface water quality standards (Table 1 of Attachment 2 to RFLMA) at the downstream POCs. Pre-discharge samples will be collected at Ponds A-4, B-5, and C-2 on North Walnut Creek, South Walnut Creek, and Woman Creek, respectively. These locations are shown on Figure 6–18.

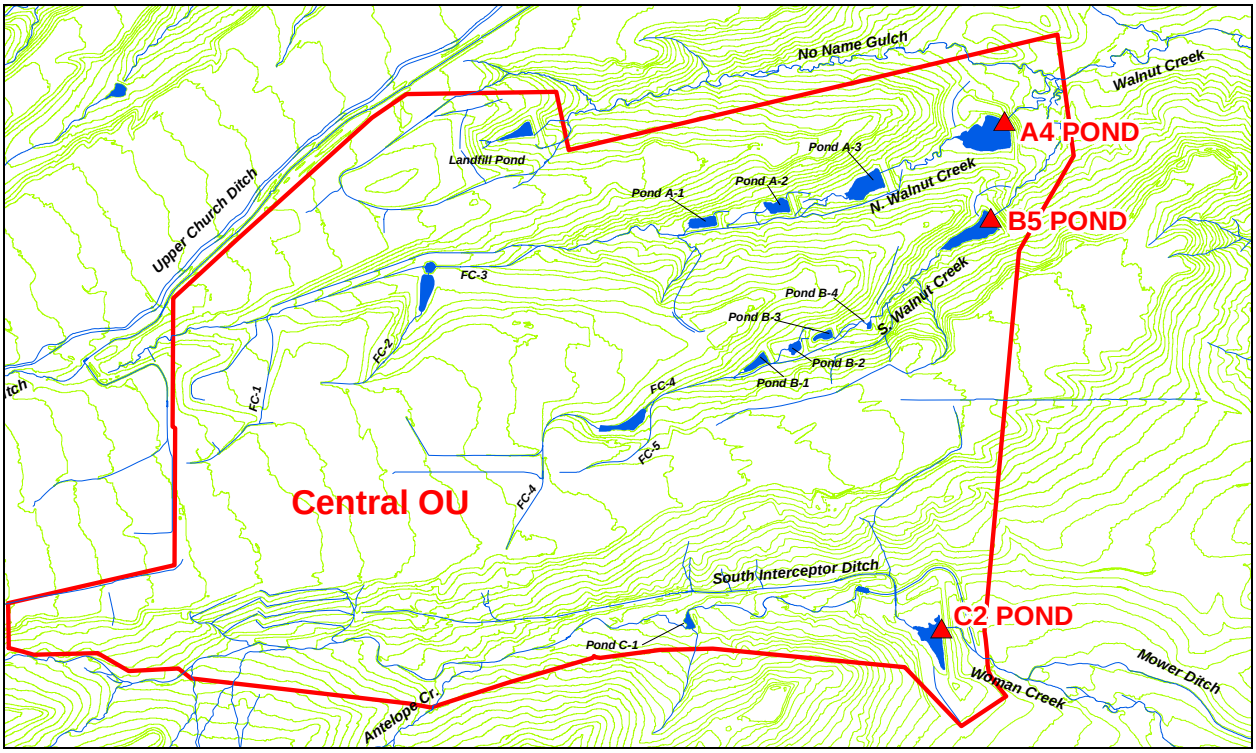


Figure 6–18. Pre-Discharge Sampling Locations

Data and Sample Collection Protocols

Pre-discharge samples are collected as grab samples for POC analytes only (Table 6−36). Samples should represent the water to be discharged (i.e., grab sample locations in each pond should be chosen appropriately, and any addition of water to the discharge should be minimized after the grab sample is collected[8]).

Table 6−36. Pre-Discharge Sample Collection: Type and Analytes

Location Code	Sample Type	Analytes
A4 POND	Grab	Pu-239,240; Am-241; isotopic U[a]; nitrate
B5 POND	Grab	Pu-239,240; Am-241; isotopic U[a]; nitrate
C2 POND	Grab	Pu-239,240; Am-241; isotopic U[a]

Notes: [a]Isotopes U-233,234; U-235; U-238
Nitrate is analyzed as nitrate+nitrite; the nitrate+nitrite result is conservatively compared to the nitrate standard only.

This pre-discharge monitoring is limited to Ponds A-4, B-5, and C-2, or any other upstream pond temporarily functioning as a terminal pond. Site personnel will notify the appropriate parties in accordance with the Figure 13 flowchart in RFLMA (Attachment A2) in advance of pre-discharge pond sampling. CDPHE and EPA will be allowed the opportunity to collect duplicate

[8] Pond A-4 is the only terminal pond that can be easily isolated from significant upstream inflows. However, pre-discharge samples will be routinely analyzed on short turnaround to limit the amount of inflow to Ponds B-5 and C-2 after sampling.

or split samples. Samples will be analyzed far enough in advance of a routine discharge to allow action to be taken if unacceptable water quality is indicated, but near enough to the time of discharge to be representative of the discharge composition. Note that the ponds will be operated to maintain dam safety regardless of the status or results of pre-discharge sampling.

Data Evaluation

Pre-discharge sampling results are evaluated according to the Figure 13 flowchart in RFLMA (Attachment A2).

6.1.12 No Name Gulch Flow Monitoring

This monitoring objective deals with the measurement of streamflow in No Name Gulch at the confluence with Walnut Creek. No Name Gulch is a small tributary to Walnut Creek, north of the COU, comprising a drainage area of approximately 300 acres. The PLF is located in the upper reaches of No Name Gulch. Flow in No Name Gulch is characterized by intermittent periods of baseflow in the spring, with extended periods of no flow at other times of the year. During these dry periods, a significant precipitation event can result in short-term direct runoff. Flow monitoring at the downstream end of No Name Gulch (location GS33) is conducted to quantify contributions to Walnut Creek. The location of GS33 is shown on Figure 6–19.

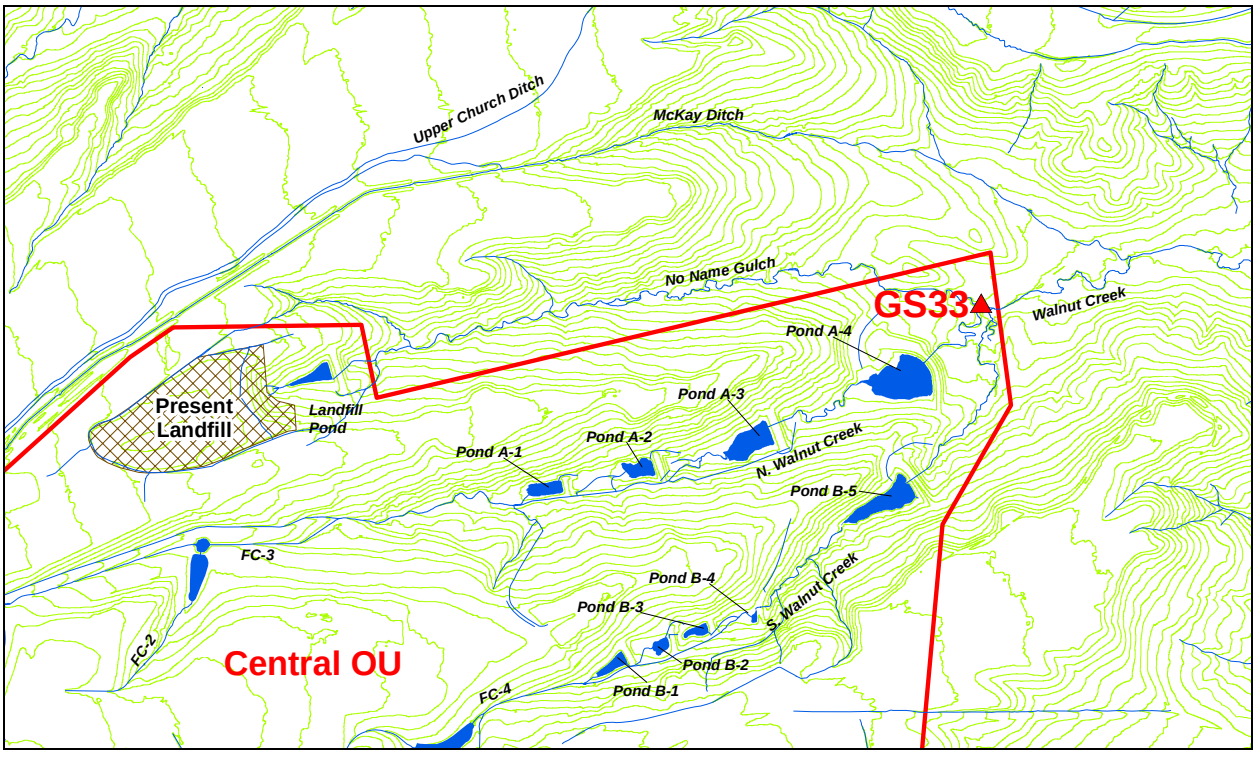


Figure 6–19. No Name Gulch Flow Monitoring Location

Data Collection Protocols

Details on instrumentation for the No Name Gulch flow monitoring location are provided in Table 6−37. Continuous flow data are collected using automated instrumentation.

Table 6−37. No Name Gulch Flow Monitoring Location

Location Code	Location Description	Sample Collection	Field Data Collection	Primary Flow Measurement Device	Telemetry?
GS33	No Name Gulch at confluence with Walnut Creek	None	Continuous flow data at 15-minute intervals	9.5-inch Parshall flume	Yes

Note: Both 5- and 15-minute interval flow data are collected.

Data Evaluation

No specific data evaluation is required. Flow data at GS33 will be collected for information purposes only and for relative comparisons to total Walnut Creek flows.

6.1.13 Indicator Parameter Monitoring for Assessment of Analytical Water Quality Data

This monitoring objective provides for the collection of general water quality and quantity information at select locations (Figure 6–20) to be used for various data assessments. Indicator parameter data collected will be used to assess analytical measurements of constituents such as radionuclides and metals to determine whether stormwater runoff is affecting water quality. The targeted indicator parameters include total suspended solids (TSS), precipitation, and flow rate. The collection of these data will also support evaluation of erosion control measures, design of water management options, investigations into actinide transport, assessment of statistically significant changes in water quality, and management decision making.

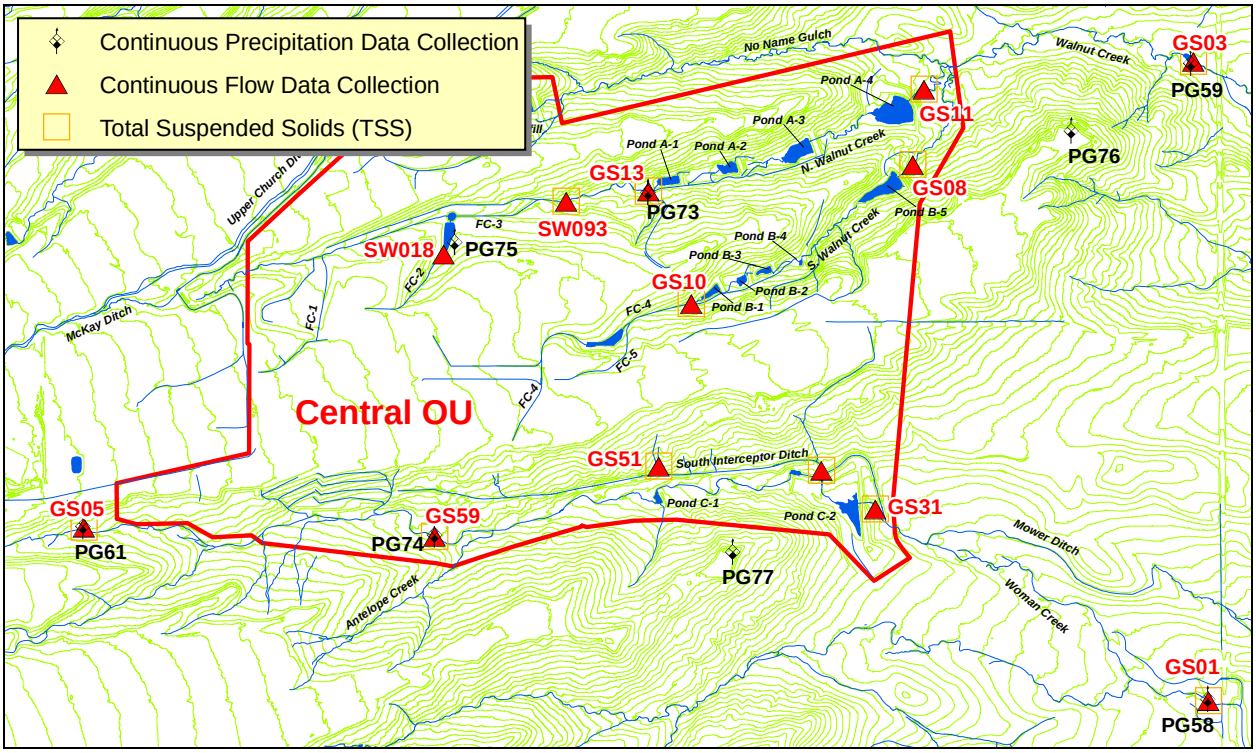


Figure 6–20. Indicator Parameter Monitoring Locations

Data and Sample Collection Protocols

To evaluate actinides in conjunction with TSS, TSS would ideally be analyzed for in all actinide samples collected at the locations covered by the other surface water monitoring objectives (Table 6−38). However, automated sampling protocols (continuous, flow-paced composites) often result in samples collected over periods exceeding the 7-day holdtime for TSS analysis. Therefore, TSS cannot be analyzed for in all composite samples, but will be analyzed for when possible.

Table 6−38. Indicator Parameter Monitoring Sample Field Data and Sample Collection

Monitoring Location	Analytical Analyses	TSS Analyses	Flow Measurement Frequency
All automated locations	As required by primary monitoring objectives	For all samples when meeting 7-day TSS holdtime requirement when also analyzing for Pu and/or Am	15-minute continuous

Notes: Sampling frequency is specified by the primary monitoring objective for each automated location.
The data collection shown above includes current parameters. Additional parameters may be added or deleted as needs arise.
Pu = Pu-239,240; Am = Am-241

To evaluate analytical constituents in conjunction with precipitation, precipitation will be monitored at eight locations across the Site (Figure 6–20). The location of precipitation gages allows for the calculation of aerial precipitation for any drainage area tributary to each

monitoring location. Each of these locations is equipped with a continuously recording precipitation gage.

To evaluate analytical constituents in conjunction with flow rate, flow is currently monitored at all automated monitoring locations at the Site. Each of these locations is equipped with a continuously recording flow-measurement device.

Data Evaluation

Table 6−39 outlines the anticipated or past data uses associated with this monitoring objective. This list provides examples of data uses; future data uses may be developed as needs arise. As such, this monitoring objective does not limit the data uses to those given below. Evaluations may be determined for any data combinations as required. For example, assessments using flow and precipitation or precipitation and TSS may be useful depending on the specific data evaluation. No specific decisions using these indicator parameter data are required.

Table 6−39. Select Data Evaluation for Indicator Parameter Monitoring Data

Data Use	Targeted Parameters	Description
Rainfall-runoff relationships	Precipitation, flow rate, flow volume	Determine hydrologic characteristics for specific drainage areas
Evaluation of TSS with flow rate	TSS, flow rate	Use flow rate measurements to predict TSS concentrations
Assessment of actinide measurements	Actinides, TSS, flow rate	Determine if cause of unusual actinide measurement is likely due to Site conditions or extreme hydrologic conditions
Modeling	Flow rate, flow volume	Perform model design, calibration, and verification
BMP assessment	TSS, flow rate	Determine effectiveness of various erosion control measures
Land configuration	Flow rate, flow volume, TSS	Assess land configuration options: determine flow routing, size hydraulic components, assess sedimentation rates, and design maintenance and operation protocols
Long-term stewardship	Flow rate, flow volume, TSS, actinides	Assess post-closure conditions

6.1.14 Water Level Wells and Water Level Measurement

The water table within the UHSU (which comprises alluvium and other unconsolidated surficial materials together with the underlying weathered portion of the bedrock) responds to seasonal and event-related changes in groundwater recharge. Water-level data are used to determine hydraulic gradients, which define groundwater flow directions. Interpretations of the fate and transport of contaminants, and potential effects of groundwater on surface water and wetlands, depend on knowledge of the hydraulic gradient, the saturated thickness of the aquifer, and the hydraulic conductivity of the geologic materials through which the groundwater flows.

Data on groundwater quantity and the magnitude and direction of groundwater flow are necessary to assess the effects of Site closure and historic operations on surface water quality. Compiling water-level information from wells supports the following routine analyses:

- Assessment of the potential impact of contaminant plumes on surface water quality through the creation of potentiometric surface maps from which horizontal hydraulic gradient and flow direction can be derived; and
- Evaluation of the groundwater monitoring network's effectiveness, using groundwater flow directions and contaminant plume information, to ensure critical data gaps do not exist.

These data can also support the following analyses, should they be necessary:

- Evaluation of impacts to downgradient habitat and endangered species caused by changes in groundwater recharge to fluvial systems as a result of Site closure and remediation activities;
- Calculation of contaminant mass flux and loading to a surface water receptor that may be impacted by a groundwater plume; and
- Development of groundwater flow and contaminant transport models to assess the effect of groundwater contamination on surface water.

Data Collection Protocols

All wells in the network will be monitored for water levels. The minimum frequency of this monitoring will be quarterly at RCRA wells supporting the PLF and OLF and semiannually at all other wells in the routine monitoring network. However, more frequent data collection can be helpful and, as a result, this activity is typically performed at the start of each quarter.

Water levels may be measured manually or using automated equipment such as pressure transducers and data loggers. If the latter method is selected, the equipment will be calibrated and checked periodically according to the manufacturer's instructions; specific items to check include battery life, reported versus measured water level (i.e., real-time, using manual methods), and data storage capacity. Data will be downloaded at a frequency that supports their use and is appropriate given equipment limitations (such as battery life), but no less frequently than annually. Automated equipment will typically be dedicated to a given well for a period of time. Before inserting dedicated equipment in a well, the appropriateness of the equipment and suitability of the well will be confirmed. Items to check include whether the groundwater at a given well is compatible with all components of the equipment (e.g., flexible insulation on data logger cables may degrade if exposed to elevated concentrations of certain VOCs), and whether the equipment is appropriately sized for the well (diameter and total length). The equipment will be carefully and gently decontaminated before it is installed in the well.

In some wells, installation of automated water level monitoring equipment may interfere with groundwater sample collection. If so, the automated equipment will be carefully removed from the well at the start of sampling activities and stored in such a manner as to prevent contamination (e.g., a large, clean plastic bag). If the equipment contacts the ground, sampling vehicle, or other potential source of cross contamination, it will be thoroughly decontaminated in accordance with the manufacturer's instructions. Following the conclusion of sampling activities

for that visit, the water level monitoring equipment will be reinstalled to the same depth as before. If problems arise, the sampling personnel will immediately contact the groundwater SME or designee to resolve the issues.

All measurements of groundwater elevations will be made with respect to the top of the inner well casing on its north side. Manual collection of water level data will be performed during the first 10 business days of the appropriate calendar quarter. This will ensure that the data are as temporally related as possible. In addition, water level measurements at each well will precede any groundwater sampling activities for which that well is scheduled. If a well was sampled a short time before these water level measurements were conducted, this will be noted. This is especially important for low-producing wells, which may take weeks to months to recover. As feasible, sampling activities at those wells may be scheduled earlier in a given quarter so that the next water level measurement more closely represents the water level in the formation.

Data Evaluation

Water level data will be evaluated at least annually and the results of the evaluation will be included in the annual report. Data from a single well are not particularly useful for flow monitoring, but instead must be compared to corresponding data from other wells in the area. Hydraulic gradients will be estimated for wells along a flowpath (which may be estimated from potentiometric surface maps) that have no intervening features that would strongly affect groundwater flow, such as groundwater intercept trenches related to the treatment systems. Refer to previously published annual reports (e.g., DOE 2008a) for additional discussion and example well pairs.

If potentiometric surface maps indicate flow directions or hydraulic gradients are changing unexpectedly with time, the monitoring network will be reviewed for data gaps or impacts to surface water that may result from these changes. If critical data gaps result from changes in flow directions, the RFLMA parties will be consulted and the monitoring network revised as appropriate.

Water level measurement is not required by RFLMA, but is performed as a BMP. This activity may be discontinued at the direction of DOE; alternatively, it may be discontinued if analytical samples are not required at a well or the next downgradient well and there is no other reason to continue water level measurements. Once this monitoring has ceased, corresponding data reviews, data reporting, and monitoring decisions will no longer be required.

6.2 Ecological Monitoring

This section describes the technical and regulatory basis for the approach to ecological monitoring in the COU. The Ecological Monitoring Program (Ecology Program) at Rocky Flats has historically focused on the characterization of ecological components in the former Buffer Zone (BZ, roughly equivalent to the current POU), natural resource conservation and management, and compliance with laws and regulations (e.g., the ESA, the Migratory Bird Treaty Act [MBTA], wetlands regulations, and weed control acts).

Ecological monitoring has been conducted continuously at Rocky Flats (both COU and POU areas) since the early 1990s with occasional earlier studies. Rocky Flats has been well

characterized in terms of both the flora and fauna. Summaries of these data can be found in the various ecology reports that have been produced over the years. A bibliography is available that lists many of the reports dealing with the ecology of the Site (Attachment E1).

Management of natural resources has been conducted since Rocky Flats became DOE property in the early 1950s. However, until the 1990s, natural resource management was mostly conducted on an occasional basis as different issues arose. With the advent of the Ecology Program at the Site in the early 1990s, management of the natural resources (weed control, revegetation, and prescribed burns) has been more proactive. Compliance with environmental regulations has been carried out by various groups depending on the media under consideration. The Ecology Program in recent years has been largely responsible for ensuring compliance with the ESA and MBTA, and focusing on wetland and noxious weed issues.

Ecological conservation and management goals include the protection of currently viable ecosystems, unique and ecologically valuable natural resources, and special-concern species, as well as compliance with wildlife and natural resource protection regulations. Early detection and management of undesirable impacts to the Site's ecological resources before they become problematic is extremely important. The Ecology Program focuses on the collection of data necessary to ensure regulatory compliance and to assess the effectiveness of DOE's natural resource conservation and habitat management efforts. These efforts are intended to comply with DOE's demonstrated desire to practice natural resource conservation (DOE 1994) and ecosystem management (Congressional Research Service 1994) on its properties.

The role of the Ecology Program at the Site is to:

- Ensure compliance with ecological environmental regulations (federal, state, and local);
- Collect ecological monitoring data, analyze data, interpret data, and prepare technical reports and other documents per specific project/regulatory requirements;
- Manage the ecological resources for long-term sustainability;
- Maintain ecological datasets for the Site; and
- Maintain historical ecology information for the Site.

Currently, ecological monitoring is conducted at the Site to:

- Ensure regulatory compliance (e.g., Preble's mouse mitigation reporting requirements and wetland mitigation reporting requirements);
- Provide useful information for management of revegetated areas and demonstrate when success criteria have been met;
- Provide information necessary to assist with the control of noxious weeds and for compliance with state noxious weed control reporting requirements (if needed); and
- Provide information necessary for wise management and conservation of native flora and fauna.

6.2.1 Regulatory Issues

The information presented below briefly outlines the regulatory issues associated with the Site's Ecology Program.

ESA Issues—Preble's Mouse Mitigation Monitoring and Management

The Ecology Program oversees and addresses the various activities that take place under the federal ESA at the Site. Currently, the species of concern at the Site is the Preble's mouse, which resides in the drainages at the Site. Although other listed species may occur nearby, they do not occur at the Site. The Preble's mouse is a federally listed, threatened species under the ESA of 1973, as amended. As a result, all activities or projects that occur in Preble's mouse habitat (defined in the PBA, Parts I and II; Attachments E3 and E4) must be consulted on as part of the Section 7 consultation requirements of the ESA. During Site closure, the PBA was written to address potential impacts to the Preble's mouse and other federally listed species resulting from cleanup and closure activities. Many DOE-LM activities are also addressed in the PBA. Four additional Biological Assessments (BAs) were written separately prior to or after the PBA documents to address other projects not included in the PBA. New activities or projects not included in the PBA must be consulted on prior to project initiation.

As part of the consultation process, after submitting the BA the USFWS issues a Biological Opinion (BO), which allows the project to proceed. The project must abide by the conservation measures, activity-specific measures, reasonable and prudent measures, and terms and conditions listed in the BO. In some cases, the BO specifies mitigation measures that must be taken by DOE to offset the impacts to Preble's mouse habitat. In these cases, mitigation monitoring and reporting requirements typically must be fulfilled annually. Until concurrence is received from USFWS that mitigation efforts are successful, the monitoring and reporting requirements continue indefinitely. The Site must request concurrence from USFWS when successful mitigation has been achieved.

After concurrence is received, the mitigation monitoring is removed from the annual monitoring list of activities. The Preble's Meadow Jumping Mouse Mitigation Tracking Spreadsheet for PBA Part II Activities is the debit/credit ledger for tracking disturbances (debits) to Preble's mouse habitat and mitigation efforts (credits) for restoring or enhancing habitat. It also contains information on how the calculations for disturbances have been made. The tracking spreadsheet is found in the annual Preble's mouse reports submitted to USFWS by December 1 of each year. (Refer to Section 15.2 for information on routine reporting.) Past annual reports submitted to USFWS provide a good overview of the type of information contained in each report. Specific monitoring, management, and reporting requirements are outlined for each project in the appropriate BA/BO.

Wetland Mitigation Monitoring and Management

During the RFP/RFETS Closure Project several wetlands were disturbed by project activities. Jurisdictional wetlands are protected under the Clean Water Act (CWA) and other regulations. At the Site, a Memorandum of Agreement (Attachment E2) between the federal agencies designates both EPA and the U.S. Army Corps of Engineers (USACOE) as having jurisdictional authority over the wetland issues at the Site. For wetland issues that result from CERCLA actions, EPA is the lead agency. For non-CERCLA actions that may impact wetlands, USACOE is typically the lead agency. Any new projects that have the potential to impact wetlands require consultation first to ensure the appropriate approvals/permits are obtained prior to project initiation. Typically EPA is contacted first; they may defer to USACOE if the project is a

non-CERCLA activity. Depending on the type of activity, EPA/USACOE will request submittal of a short document that describes the project activities and potential impacts to wetlands. In response, they may choose to cover the activity under a nationwide permit. If the project is larger, a Section 404 Permit may be required. In the latter case, a more detailed document, describing project activities and outlining potential disturbances and mitigation efforts that will be taken, is required before a permit is issued. In either case, depending on the project, the permit may list monitoring/mitigation requirements or other requirements that must be followed.

The *Rocky Flats, Colorado, Site Wetland Mitigation Monitoring and Management Plan* (RFSWP) (Attachment E7) outlines a strategy for determining whether wetland mitigation efforts have been successful and for managing the mitigation wetlands. A debit/credit spreadsheet for tracking disturbances and wetland mitigation is located at the end of the RFSWP. The RFSWP also contains the wetland monitoring and reporting requirements for the Site. Past annual reports submitted to EPA provide a good overview of the type of information contained in each report.

Migratory Bird Treaty Act

The Ecology Program oversees and addresses MBTA issues at the Site. The MBTA protects all migratory birds and their parts (including eggs, nests, and feathers). Therefore, projects at the Site need to be assessed to determine whether any potential "take" may occur. (The MBTA defines take as "any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof.") Because the removal of most of the buildings at the Site eliminated much of the nesting habitat for urban birds, MBTA issues have become much less of a concern at the Site. However, nesting birds still occur across the Site in various habitats ranging from the grasslands to the shrublands/woodlands, and a project evaluation must still be made to determine whether any impacts or take may occur. If project impacts are unavoidable, the USFWS migratory bird permit office is contacted for further information and direction. In some cases a permit is required prior to proceeding with the project. In other cases modification of the project is required. Any specific monitoring conducted pursuant to the MBTA is addressed on a case-by-case basis. The document *Migratory Bird Treaty Act Issues and Natural Resource Management Activities/Maintenance and Project Activities at the Rocky Flats Site* (Appendix K) provides guidance for MBTA issues at the Site.

Colorado Noxious Weed Act

In general, the Colorado Noxious Weed Act (CNWA) designates state noxious weeds, classifies these weeds into categories, and develops and implements management plans for control of noxious weeds in Colorado. The Ecology Program oversees and addresses CNWA issues at the Site. Depending on the species of noxious weeds found at the Site, there are potentially different control activities that must or may be conducted in addition to monitoring and reporting requirements. In recent years the CNWA has been updated annually to incorporate changes in the noxious weed list as well as new state species-specific management plans. Updates to the CNWA are posted on the Colorado Department of Agriculture website. The latest version should be evaluated prior to the field season to determine what, if any, monitoring, control efforts, and reporting requirements may be required. As changes are made to environmental rules or regulations that apply to the ecological resources at the Site, the scope of the Ecology Program may be modified to address these changes.

Notifications/Consultations

Depending on project locations and planned activities, notifications may be required for ESA, wetland, and/or MBTA issues. All planned projects should be evaluated for these issues during the early planning stages and prior to scheduling activities to prevent project delays, should consultation and permits be required prior to conducting the project. For some projects, notifications prior to project initiation are required under existing agreements or permits. For other projects, new consultation will be required because they have not been previously addressed with the regulatory agencies.

6.2.2 Natural Resource Management

The Ecology Program also oversees and directs the natural resource management activities at the Site. The natural resource management goal at the Site is to exercise good stewardship for the preservation and long-term sustainability of the natural resources while complying with applicable federal, state, and local regulations. Prior to completion of the RFP/RFETS Closure Project, the total area that DOE managed was approximately 6,400 acres. After the transfer of land to USFWS for the Rocky Flats National Wildlife Refuge, the DOE-retained lands comprise approximately 2,240 acres with most of that consisting of the former IA, the western BZ near the mines, and a small portion of the undisturbed BZ. The COU is approximately 1,300 acres in size. General goals for different community types, species of particular interest, and regulatory compliance issues are presented in Table 6−40.

Table 6−40. Conservation and Management Goals

Community	Goal
Grasslands	Maintain the quantity and quality of the vegetation community, and maintain the populations of bird and mammal species characteristic of the grasslands
Wetlands	Maintain the quantity and quality of the vegetation community, and maintain the populations of bird and mammal species characteristic of the wetlands
Great Plains Riparian Woodland Complex	Maintain the quantity and quality of the vegetation community, maintain populations of bird and mammal species characteristic of the riparian woodland complex, and maintain the abundance and extent of Preble's mice within the habitat
Mitigation Wetlands	Manage the mitigation wetlands for reestablishment of native plant and wildlife species
Revegetation Areas	Manage the revegetation areas for reestablishment of native plant and wildlife species
Aquatic Community[a]	Maintain the quality of aquatic communities at the Site, including macro-invertebrate and vertebrate species characteristic of the community
Species of Particular Interest	**Goal**
Preble's Mouse Populations	Maintain the quantity and quality of Preble's mouse habitat, and protect existing populations of the Preble's mouse
Regulatory Compliance	**Goal**
Threatened and Endangered Species and Species of Special Concern	Protect threatened and endangered species and species of special concern at the Site, and comply with applicable state and federal threatened and endangered species protection regulations and policies
Threatened and Endangered Species Habitat Mitigation	Reestablish Preble's mouse habitat at project disturbances per requirements of USFWS regulatory documents
Migratory Birds	Protect migratory birds at the Site, and comply with applicable state and federal migratory bird protection requirements
Wetlands	Protect Site wetlands, and comply with applicable state and federal wetland protection requirements
Wetland Mitigation	Reestablish wetlands (where required) at project disturbances per requirements of EPA and USACOE regulatory documents
Noxious Weeds	Protect the plant communities from invasion by noxious weeds and comply with the CNWA and other applicable noxious weed regulatory regulations and policies

Vegetation Management

Vegetation management activities have been conducted for many years at the Site. These activities have included revegetation of disturbed areas, integrated weed management (including use of administrative, cultural, mechanical, biological, and chemical controls), prescribed burns, and mowing. These activities, as well as grazing, may be options for future vegetation management at the Site. Two plans are currently available that provide basic vegetation management guidance at the Site: the RFSRP (Attachment E5) and the *Rocky Flats, Colorado, Site Vegetation Management Plan* (RFSVMP) (Attachment E6).

The RFSRP provides basic guidance for revegetation activities at the Site and includes specific seed mixes for different plant communities. It is not a regulatory document and is occasionally updated to reflect changes to improve revegetation techniques and/or methods. It also includes some basic criteria for evaluating revegetation success.

The RFSVMP provides basic guidance for an integrated weed management approach to noxious weed control at the Site. It includes discussions of the use of administrative, cultural, mechanical, biological, and chemical noxious weed controls. It also notes the potential use of prescribed burns and grazing for vegetation management; introduction of either of these actions would require development of more specific plans before either could be conducted. The RFSVMP is not a regulatory document but is occasionally updated to reflect changes to improve weed control techniques and/or methods at the Site.

General monitoring methods that are currently in use and have been used in the past are discussed in the *Ecological Monitoring Methods Handbook for the Rocky Flats, Colorado, Site* (Attachment E9). Depending on the data needs, additional methods may be developed or used.

Wildlife Management

Wildlife monitoring has been conducted in the past to inventory the fauna, provide an indication of the abundance of the various wildlife species that occur at the Site, and/or answer specific wildlife questions. Past studies have included small mammal trapping, Preble's mouse surveys, relative abundance surveys, breeding bird surveys, aquatic surveys (fish surveys), prairie dog surveys, raptor surveys, herpetological surveys, aquatic and terrestrial arthropod surveys, and annual deer counts. Depending on the type of monitoring conducted, special collection permits from the regulatory agencies are sometimes required prior to monitoring.

Potential future wildlife monitoring issues may be related to chronic wasting disease, prairie dog relocations, or other unforeseen activities. Coordination with the Colorado Division of Wildlife (CDOW) and/or USFWS may be required for some of these activities. General wildlife monitoring methods that have been used in the past are discussed in the *Ecological Monitoring Methods Handbook for the Rocky Flats, Colorado, Site* (Attachment E9). Depending on the data needs, additional methods may be developed or used.

6.2.3 Ecological Monitoring Planning Process

Ecological monitoring at the Site consists of monitoring conducted for regulatory compliance as well as BMP monitoring. Regulatory compliance monitoring consists of the monitoring required by regulatory agreements—primarily Preble's mouse and wetland mitigation monitoring. Additional monitoring for MBTA compliance issues may also be required depending on specific project needs. Monitoring for BMPs is conducted to provide information for wise management of the natural resources at the Site. Examples of this type of monitoring include identifying weed infestation locations, evaluating weed control efforts, identifying locations of active prairie dog towns in relation to the landfills, and assessing revegetation success and the need for additional management actions. The latter type of monitoring varies from year to year depending on the information needed.

The decision to conduct a specific type of ecological monitoring should be based on a need for information, not just for the sake of monitoring. As mentioned above, there are regulatory requirements that have specific information "needs," in addition to natural resource management where monitoring information can help improve techniques and methodologies and determine whether objectives are being met. Issues that should be considered for both types of monitoring when developing the annual ecological monitoring schedule are provided below. Note that the

lists are simply a starting point for consideration. Other aspects may be added, and over time some of the regulatory drivers will no longer apply as agency concurrence for mitigation projects is received and monitoring is no longer a requirement. BMP monitoring may also vary from year to year based on changing conditions at the Site and resource management needs.

Regulatory Monitoring Issues

Questions to be addressed when devising monitoring to meet regulatory requirements include:

- What regulatory agreements or documents does DOE have currently that require ecological monitoring at the Site?
- Are there any other regulations that apply to the Site that require ecological monitoring?
- What specific types of ecological monitoring are required in these agreements or documents?
- Are specific monitoring methodologies required? What are they?
- Is monitoring required to be conducted during specific timeframes? If so, when?
- What reporting requirements are there? If any, when are reports due?

The typical types of ecological regulatory issues and their regulating agencies are presented in Table 6−41.

Table 6−41 Regulatory Issues to Consider

Issue	Agency	Comments
ESA	USFWS	Preble's mouse mitigation monitoring, Adaptive Management Plan monitoring
Wetlands	EPA and/or USACOE	Wetland mitigation monitoring
MBTA	USFWS	Nesting birds, etc.
Nationwide Permits	USACOE	Certificates of Completion
CNWA	State of Colorado	Noxious weed issues
Wildlife	CDOW/USFWS	Prairie dog issues, wildlife management issues

BMP Monitoring Issues

Vegetation Monitoring Issues—Things to Consider

- Revegetation—Establishment, success/failure, and management actions (impacts, effectiveness);
- Weed control—Effectiveness on target species, impacts to non-target species, targeting control efforts, evaluating specific species, and searches for new noxious weed species;
- Prescribed burn/wildfire—Effects, success/failure, and management actions;
- Grazing—Effects, success/failure, and management actions;
- Mapping—Vegetation, wetland, weed, and Preble's mouse habitat;

- Photopoint monitoring;
- Native plant community management—Weed control, prescribed fire, grazing, drought, and interseeding; and
- Additional issues that may arise or have informational needs.

Wildlife Monitoring Issues—Things to Consider

- Preble's mouse issues—See regulatory issues;
- Prairie dog issues/impacts—Locations of prairie dog towns in relation to landfills (mapping), other remedy locations, and population counts;
- Deer/elk populations—Herd size, carrying capacity, habitat impacts, and chronic wasting disease;
- Raptors—Nesting sites and abundance (see MBTA regulatory issues);
- Waterfowl, songbird—Abundance and nesting areas (see MBTA regulatory issues);
- Amphibian/reptile—Abundance and habitat areas;
- Mosquito control issues; and
- Additional issues that may arise or have informational needs.

Ecological Monitoring Methodology

Various types of ecological monitoring methodologies are available and should be chosen on the basis of information needs, cost-effectiveness, ease of data collection, and practicality. The typical ecological monitoring methodologies that have been used in the past and continue to be used at the Site are listed in the *Ecological Monitoring Methods Handbook for the Rocky Flats Site* (Attachment E9). If comparison to older data sets is required, the same monitoring methodologies used to collect the earlier data should be used so that the data are directly comparable. If long-term monitoring is being implemented, the choice of methodologies should minimize subjectivity between observers and provide for repeatability. Many resources are available that provide additional detail for both vegetation and wildlife monitoring methodologies. These should be utilized as needed. Several suggested resources are provided below. Others are available from libraries or online resources.

Additional ecological monitoring methodology resources:

Avery, T.E., 1975. *Natural Resources Measurement*, McGraw Hill, New York, 331 p.

Avery, T.E. and H.E. Burkhart, 1995. *Forest Measurements*, 3rd ed., McGraw-Hill Publishing Company, New York.

Bonham, C.D., 1989. *Measurements for Terrestrial Vegetation*, Wiley, New York.

Bureau of Land Management, 1996. *Sampling Vegetation Attributes: Interagency Technical Reference, BLM National Applied Resource Sciences Center*, BLM/RS/ST-96/002+1730, Supersedes BLM Technical Reference 4400-4, Trend Studies, dated May 1995, 163 p.

Cooperrider, A.V., R.J. Boyd, and H.R. Stuart, 1986. *Inventory and Monitoring of Wildlife Habitat*, U.S. Department of Interior, Bureau of Land Management Service Center, Denver, Colorado, 858 p.

Greig-Smith, P., 1983. *Quantitative Plant Ecology*, 3rd ed., University of California Press, Berkeley, California, 347 p.

Holthausen, R., R. Czaplewski, D. DeLorenzo, G. Hayward, W. Kessler, P. Manley, K. McKelvey, D. Powell, L. Ruggiero, M. Schwartz, B. Van Horne, and C. Vojta, 2005. *Strategies for Monitoring Terrestrial Animals and Habitats*, Gen. Tech. Rep. RMRS-GTR-161, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado, 34 p.

Husch, B., C.I. Miller, and T.W. Beers, 1982. *Forest Mensuration*, John Wiley and Sons, New York, 402 p.

Mueller-Dombois, D. and H. Ellenberg, 1974. *Aims and Methods of Vegetation Ecology*, Wiley, New York, 547 p.

Pilz, D., H. Ballard, and E. Jones, 2006. *Broadening Participation in Biological Monitoring: Handbook for Scientists and Managers*, Gen. Tech. Rep. PNW-GTR-680, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon, 131 p.

Tueller, P.T., 1988. *Vegetation Science Applications for Rangeland Analysis and Management*, Kluwer Academic Publishers, Boston, 642 p.

USDA Forest Service, 1997. *Vegetation Monitoring: An Annotated Bibliography*, Caryl Elzinga and Angela Evenden (compilers), Intermountain Research Station Gen. Tech. Report INT-GTR-352, Ogden, Utah, 184 p.

Winward, A., 2000. *Monitoring the Vegetation Resources in Riparian Areas*, Gen. Tech. Rep. RMRSGTR-47, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah.

6.3 Air Quality Monitoring

In the past, the air monitoring program at the RFP/RFETS has included ambient (Radioactive Ambient Air Monitoring Program), effluent, and meteorological monitoring activities. As of September 2005, only ambient monitoring was voluntarily performed at two locations along Indiana Street to confirm low emissions. DOE-LM ceased ambient air monitoring at the end of September 2008.

Representative meteorological data continue to be gathered adjacent to the Site from the National Wind Technology Center (NWTC) M2 tower, located approximately 1.5 miles northwest of the COU. The NWTC M2 tower data are queried by Site staff as needed.

6.4 Exit Strategy for Water Monitoring

Water monitoring at the Site will not be required forever because contaminant concentrations are expected to decrease through natural attenuation mechanisms. Therefore, rules have been established to logically guide termination of water monitoring. The logical process by which this monitoring is terminated is referred to as the "exit strategy."

Concentrations below which monitoring for the various water contaminants is no longer needed will vary based on analyte, media (groundwater versus surface water), and monitoring classification. For example, wells at a groundwater discharge area will be held to stricter requirements than wells within a pediment-top contaminant source area because of the importance of protecting surface water quality at the discharge area. Similarly, exit criteria for surface water locations and groundwater treatment systems vary from those for monitoring wells.

Ceasing to monitor water may take place area-by-area, rather than for the Site as a whole, and may also occur by analyte suite (e.g., example, discontinuing monitoring a given well or group of wells for uranium but continuing to monitor for VOCs). As concentrations of contaminants in groundwater in a given area decrease to the point that they meet exit criteria, there will no longer be a need to monitor groundwater in that area. Similarly, as groundwater in an area ceases to be a threat to surface water quality and is no longer monitored, nor is upstream surface water, corresponding surface water monitoring reductions are appropriate.

Specific exit criteria are presented in the flowcharts in Attachment 2 to RFLMA (Attachment A2 to this document). The consultative process will be employed to make sure the RFLMA parties are included in the decision to stop monitoring. The decision to exit monitoring will be documented in a RFLMA Contact Record and incorporated into Attachment 2 to RFLMA during the next revision.